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ABSTRACT

One of the impediments to the introduction of composite structure into Australian Defence Force (ADF) aircraft is the difficulty in identifying those airworthiness requirements specific to these materials. The ADF uses a comparative approach where tenderers propose their own certification basis. This is assessed against the ADF comparative certification basis to ensure that all relevant issues are covered in adequate depth. The ADF comparative certification basis is DEF STAN 00-970 [2] supplemented with AAP 7001.054 [1]. This basis was reviewed. Those requirements relevant to the airworthiness of composite structure were identified and are presented in this report. The requirements for any specific composite part will likely be a sub-set of these and must be developed on a case-by-case basis.

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Executive Summary (U)

The Australian Defence Force (ADF) maintains a keen interest in the application of composite materials to aircraft structures. The reduced weight and improved resistance to fatigue and corrosion degradation offer the potential to improve aircraft performance while reducing through-life-support costs. Many current aircraft contain significant quantities of monolithic and bonded composite material. This appears likely to increase in future acquisitions. In addition the ADF has a long history of using bonded composite repairs to support its fleet. Despite this background, virtually all of the composite structure within ADF aircraft, particularly primary structure, has been certified outside of Australia.

One reason for this is the difficulty in identifying the specific set of airworthiness design requirements against which the composite structure will be certified. Currently there is no documentation that does this.

The ADF airworthiness policy (Australian Air Publication 7001.054 [1]) states that contractors should submit their proposed certification basis and this will be assessed by the Commonwealth against a comparative basis. The ADF comparative basis is the UK Ministry of Defence's DEF STAN 00-970 [2], supplemented with AAP 7001.054 to account for specific ADF requirements. These documents focus on traditional metallic aircraft structure, so their layout and treatment of issues is not optimised for composites.

DEF STAN 00-970 and AAP 7001.054 were reviewed and, in this report, the requirements and guidance considered relevant to composite structure are collated and re-arranged into a more logical format for composites. This is the first time that the airworthiness requirements relevant to composite structure have been identified and extracted from the ADF comparative airworthiness standards.

The certification requirements for any specific composite part must be developed on a case-by-case basis. The requirements identified in this report cover all possible composite structures, from a non-structural part to an entire aircraft. The requirements for any specific part will likely form a sub-set of these.

Contents

1. Introduction

The Australian Defence Force (ADF) maintains a keen interest in the application of composite materials to aircraft structures. The reduced weight and improved resistance to fatigue and corrosion degradation offer the potential to improve aircraft performance while reducing through-life-support costs. Many military aircraft currently in production contain significant quantities of monolithic and bonded composite material. The use of composites appears likely to increase in future generations of aircraft. In addition, the ADF has a long history of using bonded composite repairs to support its fleet. Despite this background, virtually all of the composite structure within ADF aircraft, particularly primary structure, has been certified outside of Australia.

A contributing factor to the lack of composites certification is the difficulty in identifying the airworthiness requirements that must be met by composite structure. To address this situation the comparative airworthiness design requirements for ADF aircraft were reviewed and those sections considered relevant to composites have been extracted and collated in a format that is logical for composites.

2. Airworthiness Certification for ADF Aircraft

Significant effort and expense is required to certify metallic or composite aircraft structure. It is therefore strongly recommended that the certification issues be addressed as early as possible in any project. Policy regarding the application of airworthiness design standards within the ADF, i.e. airworthiness certification, is given in AAP 7001.054 [1]. The ADF has adopted a comparative approach where, for any acquisition or major upgrade, tenderers propose their own certification basis. In this context the term certification basis describes the complete set of airworthiness design requirements and so includes the effects of updates, improvements, special conditions or directives to standards. This proposed certification basis is assessed, by the Technical Airworthiness Regulator (TAR) or their nominated Centre of Expertise, against the ADF comparative certification basis. Any differences between the ADF and the tenderer are resolved by negotiation. The Directorate General Technical Airworthiness (DGTA) is the ADF TAR.

The ADF comparative certification basis is the UK Ministry of Defence (MoD) Standard DEF STAN 00-970 [2], supplemented by Sections 2 to 4 of AAP 7001.054 to address known deficiencies in DEF STAN 00-970 when it is applied to the ADF. AAP 7001.054 states that DEF STAN 00-970 was chosen as the comparative standard because it is an accessible, comprehensive, military airworthiness standard and not because it has been judged any more, or less, safe or complete than other military or civil standards.

Sections 2.1 to 2.6 below provide a summary of the airworthiness certification process within the ADF.

2.1 Contractor proposes certification basis

The ADF comparative certification basis is DEF STAN 00-970 supplemented with AAP 7001.054. Contractors may choose to use this as their certification basis, or propose their own. While this non-prescriptive approach permits innovative solutions, and these types of solutions are encouraged, it is the responsibility of the contractor to convince the TAR that their approach provides an equivalent level of safety to the comparative basis. In addition, the more significant the deviation from the comparative basis then the greater the time required by the TAR to review the proposal.

The preferred approach is that the contractor submits their certification basis in the form of a Certification Basis Description (CBD). This provides the TAR with sufficient information to determine whether the certification basis will produce an airworthy structure. The CBD will eventually includes details of the certification requirement, verification method, conditions, verification agency and verification evidence documents, but at the initial submission it will only contain the certification requirements. An excerpt from a sample CBD is shown in Table 1.

The contractor shall decide the level of detail provided in the CBD. It shall be sufficiently detailed to demonstrate that all issues have been covered, but not so detailed that it loses its effectiveness as a management tool. Ref. [1] stated that an adequately detailed CBD for an aircraft that was certified to FAR 25 would normally be achieved by numbering every section of FAR 25 (e.g. 25.1309) on a separate line of the CBD. This equates to the third order headings in the comparative certification basis shown in Table 2 or each of the items in the summary Table 3.

2.2 Acceptance of certification basis

The contractor shall negotiate the acceptance of the certification basis with the TAR and the CBD shall be modified accordingly. Ideally this process will be complete at the pre-tender stage.

2.3 Contractor proposes means of demonstrating compliance

The CBD shall be expanded to include the contractor's proposed approach to demonstrate compliance with each of the certification requirements and the agency responsible for verifying compliance. The verification methods include inspection, analysis, test and similarity with parts that have received prior certification.

Table 1: Example certification basis description for composite structure

Contract clause	Airworthiness requirement	Design standard	Revision status	Verification method	Conditions (Waivers, deviations, etc)	Verification agency	Similarity (type details)	Verification evidence documentation (Produced by Contractor)
	General requirements	DEF STAN 00-970 1.1.3-12	Issue 2	A, T				Assembly specifications
	Operation in various climatic regions	DEF STAN 00-970 7.1.9-14	Issue 2	A, T				Design report, test report
	General detail design	DEF STAN 00-970 4.1.2-42	Issue 2	A				Design report
	Processes and working of materials	DEF STAN 00-970 4.6.2-14	Issue 2	A, T				Design report Manufacture, assembly and installation specifications
	Precautions against corrosion and deterioration	DEFSTAN 00-970 4.3.104-116	Issue 2	I				Manufacture, assembly and installation specifications
	Ice protection	DEF STAN 00-970 6.9.29-36	Issue 2	A. T				Design report, Test report
	Peel Ply	TAR requirement 1.1.7.1		I				Manufacture and assembly specifications

For Verification Methods: I = Inspection A = Analysis T = Test S = Similarity (Prior Clarification)

Any airworthiness issues, judged by the TAR or Project Office (PO) to be significant enough to require recording of their resolution in the CBD, shall be the subject of an Issue Paper (IP). An IP ensures the visibility of these airworthiness issues and details all the information relevant to that issue. The reasons for raising IP's include; clarification of existing requirements, addition of new requirements, recording of proposals for wavers, deviations, special conditions or Equivalent Safety Findings (ESF's), recording of insufficient evidence to support compliance findings, or providing a mechanism to record TAR policy prior to inclusion in AAP 7001.054. The format and issuing of Issue Papers are discussed in detail in Section 1 Chapter 3 of AAP 7001.054.

2.4 Acceptance of means of demonstrating compliance

The contractor shall negotiate the acceptance of the means of demonstrating compliance with the TAR. The CBD shall be modified to record any changes. By the time the request-for-tender is released the proposed means of establishing compliance should also be specified. Again, any differences between the ADF and tenderer are to be resolved by negotiation. This resolution should be complete before any contract is entered.

2.5 Contractor to demonstrate compliance

The contractor shall demonstrate compliance to the agreed verification agency using the means agreed in the CBD. This will require the generation, review and acceptance of detailed certification submissions including test reports, generic and specific ESF's, engineering drawings, stress reports, design reports and IP's. The CBD shall be updated as compliance findings are made, by referencing the evidence that the responsible agency has made the compliance finding.

2.6 ADF acceptance

The TAR will accept the airworthiness of the composite structure when acceptable compliance findings have been made against all issues in the CBD.

3. Format of the Comparative Certification Basis for Composite Structure

This section describes the format of the certification requirements shown in Section 4 of this report and references the documents on which it is based.

As with most airworthiness standards, DEF STAN 00-970 and AAP 7001.054 focus on traditional metallic structure. These documents are periodically amended and over the last thirty years a number of specific requirements and guidance regarding the use of composites have been added. However these do not cover all applicable issues.

Therefore DEF STAN 00-970, Issue 1, Amendment 14 (DEF STAN 00-970/1 (AL14)) and AAP 7001.054(AM1) were reviewed and all requirements and guidance considered relevant to composite structure were extracted. Summaries of the extracted sections of DEF STAN 00-970/1 (AL14) and a complete listing of the Chapters are given in Appendix A. This Appendix should permit the reader to obtain an accurate reflection of the scope of this standard, plus a broad understanding of the contents of the DEF STAN 00-970/1 (AL14) requirements related to composite structure. However, for specific advice the reader must refer to the source document.

The sequence and treatment of many issues in DEF STAN 00-970 originated from the certification of metallic aircraft structure and is thus not optimal for composites. The Federal Aviation Administration (FAA) Advisory Circular (AC) 20-107A [3] is widely recognised as the state-of-the-art certification document for composite materials. It describes an acceptable means of demonstrating compliance with the requirements of Federal Aviation Regulation (FAR) Part 25 [4], the FAA requirements for the airworthiness certification of transport aircraft. Almost all large civilian aircraft are certified to this requirement, or the almost identical European equivalent, Joint Aviation Regulation (JAR) Part 25 [5].

As would be expected, the format of AC 20-107A is logical and appropriate for composite structures. Thus the section headings used in AC 20-107A were used as section headings for the comparative basis shown in Section 4 of this report. However, FAR's and JAR's relate to civil aircraft while DEF STAN's relate to military operations. The additional issues arising from military operation, or from the added responsibility that regulating, owning, operating and maintaining its aircraft places on the ADF, were added to the comparative certification basis.

The requirements within each section of the comparative certification basis were divided into; general requirements, design cases, specific structures and flight testing. This is intended to simplify the formulation of, and comparison with, any proposed certification basis. To further simplify cross-referencing with DEF STAN 00-970/1, Appendix B gives the requirements of the comparative basis in order of the DEF STAN 00-970/1 Chapters.

DEF STAN 00-970/1 is divided into ten parts, with each part containing Chapters and Leaflets. The Chapters define the certification requirements and it is compulsory that the proposed certification basis address all of these requirements. It is acknowledged that in some cases the requirements, as written in DEF STAN 00-970/1, will not be directly applicable to the certification of composite structure. In these cases the tenderer using the comparative certification basis in Section 4 must interpret the intention of the requirement and submit this interpretation as part of their proposed certification basis.

The Leaflets supplement the Chapters by clarifying the requirements, explaining the reasoning behind requirements, and providing recommendations or advice on acceptable means of demonstrating compliance. It is therefore not compulsory to

follow the advice given in the Leaflets. However, if guidance on any issue is given and the tenderer using this comparative basis proposes to deviate from this guidance, then a justification for the deviation should also be submitted with their proposal.

DEF STAN 00-970/1 (AL14) was reissued as DEF STAN 00-970/2 [6] on 1 December 1999. This restructure was intended to enable greater flexibility and facilitate further review of DEF STAN 00-970/2. The three major features of this reissue were:

1. all requirements, apart from the requirements for fatigue and data recording systems, were unchanged,

2. the format of the document was changed extensively. In contrast with the Chapters and Paragraphs used in DEF STAN 00-970/1, DEF STAN 00-970/2 is presented as clauses. It is divided into nine parts, each part is divided into a maximum of nine sections, and each section divided into clauses. The clauses contain the detailed technical requirements. The structure of DEF STAN 00-970/2, in the form of an abbreviated table of contents, is shown in Appendix C.

3. the paragraphs from DEF STAN 00-970/1 (AL14) were interpreted and classified as "requirement", "compliance" or "guidance". The clauses in DEF STAN 00-970/2 are presented under these headings.

Part 1 of DEF STAN 00-970/2, denoted DEF STAN 00-970 (PART 1)/2, details the airworthiness certification requirements for combat aircraft. The clauses from DEF STAN 00-970 (PART 1)/2, corresponding to the selected Chapters/Paragraphs from DEF STAN 00-970/1 (AL14), are included in the comparative certification basis in Section 4.

4. Airworthiness Requirements for Composite Aircraft Structure

Table 2 shows the requirements, derived from DEF STAN 00-970, AAP 7001.054 and those acknowledged in Section 7, that were identified as relevant to the airworthiness certification of composite aircraft structure. It is likely that the third order headings from Table 2 will be suitable as individual line items in a CBD. These headings are shown in Table 3.

Table 2: Certification basis for composite aircraft structure based on the requirements of DEF STAN 00-970.

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
1. MATERIAL AND FABRICATION DEVELOPMENT				
Aim:	To ensure suitable, (i) design database (that includes the effects of environment and impact on material properties), (ii) manufacture processes and (iii) assembly processes.			
Compliance:	Typically by test. Experience with the same or similar materials/processes, results from previous test programmes and validated analytical techniques may be used to reduce the extent of testing.			
1.1 General Requirements				
1.1.1 General Requirements				
STANDARD ITEMS				
1.1.1.1	100	2	1.1.3	Requirements of appropriate standards
INSTALLATION INFORMATION FOR ITEMS OF EQUIPMENT				
1.1.1.2	100	3	1.1.4	Installation instructions
STRENGTH				
1.1.1.3	100	4	1.1.5	Applicability of strength clauses
TESTS				
PROTOTYPE TESTS				
1.1.1.4	100	6	1.1.7	Applicability and extent of prototype tests
COMPONENT TESTS				
1.1.1.5	100	6	1.1.8	Separate specifications for components
PREVENTION OF INCORRECT ASSEMBLY OF SYSTEMS				
1.1.1.6	100	7	1.1.9	Parts that may cause accidents or damage
1.1.1.7	100	7	1.1.10	Other parts
1.1.1.8	100	7	1.1.11	Fluid systems
CONDITIONS OF OPERATION				
1.1.1.9	100	8	1.1.12	Function of installations and systems
1.1.2 Operation In Various Climatic Regions				
TEMPERATURE				
1.1.2.1	101	1	7.1.9	Worldwide temperatures
1.1.2.2	101	1	7.1.10	Capability for worldwide flight
1.1.2.3	101	1	7.1.11	Landing
1.1.2.4	101	1	7.1.12	Equipment
1.1.2.5	101	1	7.1.13	Arctic testing for new types of aeroplane
HUMIDITY				
1.1.2.6	101	2	7.1.14	Design humidity-temperature envelope
1.1.2.7	101	L0	S7/L0	References
1.1.2.8	101	L2	S7/L1	Operation in various climatic conditions - Standard atmospheric conditions
1.1.2.9	101	L3	S7/L2	Operation in various climatic conditions - Temperature limits for design purposes
1.1.2.10	101	L4	S7/L3	Operation in various climatic conditions - Humidity conditions

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
1.1.3 General Detail Design				
GENERAL				
1.1.3.1	400	1	4.1.2	Minimise parts
1.1.3.2	400	1	4.1.3	Safety factor
GRADING OF PARTS AND ASSEMBLIES				
INTRODUCTION				
1.1.3.3	400	2	4.1.4	Appropriate quality control and testing
1.1.3.4	400	2	4.1.5	Grading of standard parts
GRADING REQIUREMENTS				
1.1.3.5	400	2	4.1.6	Grade A selection criteria
1.1.3.6	400	2	4.1.7	Grade B selection criteria
DRAWINGS AND QUALITY CONTROL				
1.1.3.7	400	2	4.1.8	Quality control requirements on drawings
1.1.3.8	400	2	4.1.9	Additional quality control requirements
STANDARD PARTS				
1.1.3.9	400	3	4.1.10	Requirements of other standards
1.1.3.10	400	3	4.1.11	Other series
1.1.3.11	400	3	4.1.12	Issue number of drawing
MATERIALS AND PROCESSES				
1.1.3.12	400	4	4.1.13	Material and manufacture processes for Grade A parts
1.1.3.13	400	4	4.1.14	Specification for unapproved material or processes on Grade A parts
1.1.3.14	400	4	4.1.15	Material specifications for Grade B parts
STRENGTH OF MATERIALS				
1.1.3.15	400	5	4.1.16	Guidance regarding strength of defined materials
LOCKING OF THREADED FASTENERS				
1.1.3.16	400	7	4.1.18	Standard of locking
1.1.3.17	400	7	4.1.19	Grade A applications
1.1.3.18	400	7	4.1.20	Grade B applications
1.1.3.19	400	7	4.1.21	Locking wire
1.1.3.20	400	7	4.1.22	Centre popping
1.1.3.21	400	7	4.1.23	Peening
1.1.3.22	400	7	4.1.24	Locking adhesives
1.1.3.23	400	7	4.1.25	End protrusion
1.1.3.24	400	7	4.1.26	Damage to protective treatment
USE OF COLD FORGED STEEL BOLTS				
1.1.3.25	400	9	4.1.28	Specification for cold forged steel bolts
CONTROLLED TIGHTENING OF BOLTS				
OPERATIONAL REQUIREMENTS				
1.1.3.26	400	12	4.1.34	Scope of application
1.1.3.27	400	12	4.1.35	Bolt elongation technique
1.1.3.28	400	12	4.1.36	Access for torque loading tools
SAFETY REQUIREMENTS				
1.1.3.29	400	12	4.1.37	Requirements for drawings
1.1.3.30	400	12	4.1.38	Lubricant compatibility
1.1.3.31	400	12	4.1.39	Effect of hot joints on torque upon re-assembly

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
REDUCTION OF VULNERABILITY TO BATTLE DAMAGE				
1.1.3.32	400	13	4.1.40	Material repairability and resistance to Nuclear, Biological and Chemical (NBC) attack
1.1.3.33	400	13	4.1.41	Repairable materials
1.1.3.34	400	13	4.1.42	Response to NBC effects
1.1.3.35	400	L1	S4/L1	General detail design - Grading of aeroplane parts and assemblies
1.1.4 Processes And Working Of Materials				
JOINTING PROCESSES				
1.1.4.1	402	1	4.6.2	Grading of joints made by metallic jointing processes
STRENGTH AFTER PROCESSING				
DETAIL DRAWINGS				
1.1.4.2	402	2	4.6.3	Documentation requirements for process dependant joints
1.1.4.3	402	2	4.6.4	Properties for welded joints
FLAW DETECTION				
1.1.4.4	402	4	4.6.6	Need for flaw detection
ADHESIVE BONDING				
1.1.4.5	402	6	4.6.10	Validation of Grade A components
SEALANTS AND SEALING				
1.1.4.6	402	7	4.6.11	Specification for sealing processes
1.1.4.7	402	7	4.6.12	Ensure appropriate pre-treatment on surfaces to be sealed
1.1.4.8	402	7	4.6.13	Leak resistance
1.1.4.9	402	7	4.6.14	Consideration of concentrated loads
1.1.4.10	402	L0	S4/L0	References
1.1.4.11	402	L2	S4/L16	Processes and working of materials - Adhesive bonding of structural parts - process and control
1.1.4.12	402	L3	S4/L17	Processes and working of materials - Adhesive bonding of structural parts - recommended design practice
1.1.4.13	402	L7	S4/L20	Processes and working of materials - Sealants and sealing
1.1.5 Precautions Against Corrosion And Deterioration				
PRECAUTIONS AND TREATMENTS DURING ASSEMBLY				
FIELD OF APPLICATION				
1.1.5.1	409	24	4.3.104	Scope of requirement
WET ASSEMBLY				
1.1.5.2	409	24	4.3.105	Requirement for static joints
1.1.5.3	409	24	4.3.106	Sealants
1.1.5.4	409	24	4.3.107	Jointing compounds
MATERIALS APPROVED FOR WET ASSEMBLY				
1.1.5.5	409	24	4.3.108	Preferred sealant for fuel tanks, cabin skins and pressure capsules
1.1.5.6	409	24	4.3.109	Acceptable jointing compounds
EXCEPTIONS AND SPECIAL CASES				
1.1.5.7	409	24	4.3.110	Spot and seam welds
1.1.5.8	409	24	4.3.111	Adhesive bonded joints
1.1.5.9	409	24	4.3.112	Screwed unions in liquid and gaseous systems
1.1.5.10	409	24	4.3.113	Lubricated joints
1.1.5.11	409	24	4.3.114	Joints with anti-fretting treatments

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
NON-METALLIC SHIMMING AND PACKING MATERIALS				
1.1.5.12	409	24	4.3.115	Material selection and assembly requirements
METAL SHIMS				
1.1.5.13	409	24	4.3.116	Assembly of sacrificial metal shims
1.1.6 Ice Protection				
DESIGN AND CONSTRUCTION				
1.1.6.1	712	8	6.9.29	Requirements for ice protection system
1.1.6.2	712	8	6.9.30	Strength and fatigue damage tolerance requirements
1.1.6.3	712	8	6.9.31	Requirements for the design of electrical installations
1.1.6.4	712	8	6.9.32	Material requirements
1.1.6.5	712	8	6.9.33	Temperature limiting devices
1.1.6.6	712	8	6.9.34	Insulation
1.1.6.7	712	8	6.9.35	External supplies or equipment for ground tests
1.1.6.8	712	8	6.9.36	Diameter of filling orifices
1.1.7 Peel Ply				
1.1.7.1				ADF TAR requirement - Peel ply Where peel plies are used on composite surfaces that are to be bonded, the surfaces must be abraded prior to bonding. Light grit blasting is the preferred method of abrasion. Coated peel plies should not be used.
1.2 Specific Structures				
1.2.1 Precautions Against Corrosion And Deterioration				
TREATMENT OF RADOMES				
1.2.1.1	409	22	4.3.102	Effect of materials on radar transparency
1.2.2 Attachment To Sandwich Structures				
1.2.2.1				ADF TAR requirement - Attachment to sandwich structure No fabrication, assembly or marking process shall penetrate sandwich structures.
2. PROOF OF STRUCTURE - STATIC				
Aim:	To ensure sufficient static strength of the structure.			
Compliance:	Typically through a series of ultimate load tests at the appropriate coupon/element/subcomponent/full-scale level giving due regard to service environment and degradation resulting from manufacture and service. Validated analytical techniques may be used to reduce the extent of testing.			
2.1 General Requirements				
2.1.1 General Requirements				
STRENGTH				
2.1.1.1	100	4	1.1.5	Applicability of strength clauses
TESTS				
PROTOTYPE TESTS				
2.1.1.2	100	6	1.1.7	Applicability and extent of prototype tests
COMPONENT TESTS				
2.1.1.3	100	6	1.1.8	Separate specifications for components

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
2.1.2 Static Strength And Deformation				
2.1.2.1	200	1	3.1.1	Scope of the section
2.1.2.2	200	1	3.1.2	Identification of critical design cases
2.1.2.3	200	1	3.1.3	Allowables for Grade A details
2.1.2.4	200	1	3.1.4	Requirements for ultimate and proof loads
DESIGN CASES				
2.1.2.5	200	2	3.1.5	Tracing of load paths
THE ULTIMATE STRENGTH AND PROOF REQUIREMENTS				
2.1.2.6	200	3	3.1.6	Effects of proof loads
2.1.2.7	200	3	3.1.7	Effects of ultimate load
SUBSTANTIATION OF THE STATIC ALLOWABLE STRESS FOR GRADE A DETAILS				
2.1.2.8	200	4	3.1.7	Dimensions for determination of allowables
2.1.2.9	200	4	3.1.8	Loading and environment for determining allowables
2.1.2.10	200	4	3.1.9	Basis of strength derivation
METHOD OF STRUCTURAL ANALYSIS				
2.1.2.11	200	4	3.1.10	Substantiation of method of structural analysis
DEMONSTRATION OF COMPLIANCE WITH THE ULTIMATE STRENGTH & PROOF REQUIREMENTS FOR COMPLETE STRUCTURE OR COMPONENTS				
2.1.2.12	200	5	3.1.11	Use of test factors
MEASUREMENT OF LOADS ON AEROPLANE STRUCTURES				
2.1.2.13	200	6	3.1.12	Extent of test measurement of loads and temperatures
ENGINE AND AUXILIARY POWER UNIT MOUNTING LOADS				
2.1.2.14	200	8	3.1.13	Strength and rigidity requirements for mountings
REDUCTION OF VULNERABILITY TO BATTLE DAMAGE				
2.1.2.15	200	9	3.1.14	Design approach
2.1.2.16	200	9	3.1.15	Provision of drain holes and drip fences
CONSIDERATIONS IN SETTING PERMISSIBLE FLIGHT LOADS FOR EXPERIMENTAL AND PROTOTYPE AEROPLANES				
2.1.2.17	200	10	3.1.16	Factors to be considered when determining restrictions
2.1.2.18	200	L1	S3/L1	Static strength and deformation - Principles underlying the requirements
2.1.2.19	200	L2	S3/L2	Static strength and deformation - Static structural strength test load sequence
2.1.2.20	200	L3	S3/L3	Static strength and deformation - Engine and auxiliary power unit mounting loads
2.1.2.21	200	L4	S3/L4	Static strength and deformation - Strength of structures under conditions of heating and cooling
2.1.2.22	200	L5	S3/L5	Static strength and deformation - Considerations in setting permissible flight loads for experimental and prototype aeroplanes
2.1.3 General Detail Design				
GENERAL				
2.1.3.1	400	1	4.1.2	Minimise parts
2.1.3.2	400	1	4.1.3	Safety factor

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
GRADING OF PARTS AND ASSEMBLIES				
INTRODUCTION				
2.1.3.3	400	2	4.1.4	Appropriate quality control and testing
2.1.3.4	400	2	4.1.5	Grading of standard parts
GRADING REQIUREMENTS				
2.1.3.5	400	2	4.1.6	Grade A selection criteria
2.1.3.6	400	2	4.1.7	Grade B selection criteria
DRAWINGS AND QUALITY CONTROL				
2.1.3.7	400	2	4.1.8	Quality control requirements on drawings
2.1.3.8	400	2	4.1.9	Additional quality control requirements
STANDARD PARTS				
2.1.3.9	400	3	4.1.10	Requirements of other standards
2.1.3.10	400	3	4.1.11	Other series
2.1.3.11	400	3	4.1.12	Issue number of drawing
MATERIALS AND PROCESSES				
2.1.3.12	400	4	4.1.13	Material and manufacture processes for Grade A parts
2.1.3.13	400	4	4.1.14	Specification for unapproved material or processes on Grade A parts
2.1.3.14	400	4	4.1.15	Material specifications for Grade B parts
STRENGTH OF MATERIALS				
2.1.3.15	400	5	4.1.16	Guidance regarding strength of defined materials
LOCKING OF THREADED FASTENERS				
2.1.3.16	400	7	4.1.18	Standard of locking
2.1.3.17	400	7	4.1.19	Grade A applications
2.1.3.18	400	7	4.1.20	Grade B applications
2.1.3.19	400	7	4.1.21	Locking wire
2.1.3.20	400	7	4.1.22	Centre popping
2.1.3.21	400	7	4.1.23	Peening
2.1.3.22	400	7	4.1.24	Locking adhesives
2.1.3.23	400	7	4.1.25	End protrusion
2.1.3.24	400	7	4.1.26	Damage to protective treatment
USE OF COLD FORGED STEEL BOLTS				
2.1.3.25	400	9	4.1.28	Specification for cold forged steel bolts
CONTROLLED TIGHTENING OF BOLTS				
OPERATIONAL REQUIREMENTS				
2.1.3.26	400	12	4.1.34	Scope of application
2.1.3.27	400	12	4.1.35	Bolt elongation technique
2.1.3.28	400	12	4.1.36	Access for torque loading tools
SAFETY REQUIREMENTS				
2.1.3.29	400	12	4.1.37	Requirements for drawings
2.1.3.30	400	12	4.1.38	Lubricant compatibility
2.1.3.31	400	12	4.1.39	Effect of hot joints on torque upon re-assembly
2.1.3.32	400	L1	S4/L1	General detail design - Grading of aeroplane parts and assemblies

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2.1.4 Protection From The Effects Of Nuclear Explosions, Laser Weapons, Chemical And Biological Warfare Agents				
INTRODUCTION				
2.1.4.1	723	1	9.11.1	Applicability of clauses
2.1.4.2	723	1	9.11.2	Requirements for NBC/laser hardening
2.1.4.3	723	1	9.11.3	Security classification of references
NUCLEAR ENVIRONMENT REQUIREMENTS				
GENERAL				
2.1.4.4	723	3	9.11.6	Aim of basis nuclear survivability
DESIGN				
2.1.4.5	723	3	9.11.7	Design objective for nuclear hardening
2.1.4.6	723	3	9.11.8	Principal design aim
2.1.4.7	723	3	9.11.9	Initial feasibility study
2.1.4.8	723	3	9.11.10	Consideration of effects of friendly forces weapons
OPERATIONAL CONDITIONS				
2.1.4.9	723	3	9.11.11	Flight and ground conditions at exposure
2.1.4.10	723	L2	S9/L25	Protection from the effects of nuclear explosions, laser weapons, chemical and biological warfare agents - Nuclear weapon effects on aeroplanes
2.2 Design Cases				
2.2.1 Symmetric Manoeuvres				
2.2.1.1	202	1	3.3.1	Scope of clause
FACTORS				
2.2.1.2	202	2	3.3.2	Proof and ultimate factors for structure
THE FLIGHT ENVELOPE				
2.2.1.3	202	3	3.3.3	Definition of design flight envelope
MANOEUVRES TO BE CONSIDERED				
STEADY PITCHING VELOCITY				
2.2.1.4	202	4	3.3.4	Consideration of effects of steady pitching velocity
PITCHING ACCELERATION				
2.2.1.5	202	4	3.3.5	Consideration of loads arising from sudden positive pitch
2.2.1.6	202	4	3.3.6	Consideration of loads arising from transient pitching
SUPPLEMENTARY CONDITIONS AND ASSUMPTIONS				
ENGINE POWER				
2.2.1.7	202	5	3.3.7	Consideration of effects of all likely engine power conditions
HIGH LIFT DEVICES, AIRBRAKES AND UNDERCARRIAGE				
2.2.1.8	202	5	3.3.8	Consideration of position of high lift devices
2.2.1.9	202	5	3.3.9	Consideration of effect of airbrakes
2.2.1.10	202	5	3.3.10	Consideration of effect of undercarriage position
PITCHING MOMENT COEFFICIENT				
2.2.1.11	202	5	3.3.11	Calculation of pitching moment coefficient and aerodynamic centre
OTHER AERODYNAMIC COEFFICIENTS AND DERIVATIONS				
2.2.1.12	202	5	3.3.12	Basis of aerodynamic coefficients and derivatives

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
MASS AND MASS DISTRIBUTION				
2.2.1.13	202	5	3.3.13	Ranges of mass to be considered
2.2.1.14	202	5	3.3.14	Tolerance on centre of gravity position
2.2.1.15	202	L0	S3/L0	References
2.2.1.16	202	L1	S3/L7	Symmetric manoeuvres - The calculation of the response of an aeroplane to pitch control input and associated loads when a conventional control system is used
2.2.1.17	202	L2	Part 0	Procedures for use, content and definitions
2.2.1.18	202	L3	S3/L8	Symmetric manoeuvres - The calculation of the loads associated with symmetric manoeuvres for aeroplanes having control system with load limiting devices
2.2.2 Asymmetric Manoeuvres				
2.2.2.2	203	1	3.4.1	Scope of the clause
FACTORS				
2.2.2.3	203	2	3.4.2	Proof and ultimate factors for the structure
MANOEUVRES TO BE CONSIDERED				
2.2.2.4	203	3	3.4.3	Manoeuvres to be considered in aeroplanes with load limiting devices
2.2.2.5	203	3	3.4.4	Manoeuvres to be considered in conventional aeroplanes
YAWING MANOEUVRES				
DESIGN CONDITIONS				
2.2.2.6	203	4	3.4.5	Design conditions
DESIGN CASES				
2.2.2.7	203	4	3.4.6	Determination of loads and deflections of yaw motivator(s)
2.2.2.8	203	4	3.4.7	Consideration of deflection with sinusoidal pilot input
2.2.2.9	203	4	3.4.8	Consideration of deflections from automatic control system
CROSS COUPLING CONSIDERATIONS				
2.2.2.10	203	4	3.4.9	Assumed corrective action for design cases
LONGITUDINAL STABILISER/CONTROL SURFACE LOADS				
2.2.2.11	203	4	3.4.10	Considerations in calculating loads
EFFECTS OF ASYMMETRIC ENGINE FAILURE				
2.2.2.12	203	5	3.4.11	Design of multi-engined aeroplanes
ROLLING MANOEUVRES				
2.2.2.13	203	6	3.4.12	Context for selection of rolling manoeuvres
2.2.2.14	203	6	3.4.13	Considerations of maximum roll inceptor inputs
COMBINED PITCHING AND ROLLING				
2.2.2.15	203	7	3.4.14	Consideration of effect of combined pitching and rolling
BOMB BAY AND DOOR LOADS				
2.2.2.16	203	8	3.4.15	Considerations for structure related to bomb bays
MASS AND MASS DISTRIBUTION				
2.2.2.17	203	9	3.4.16	Definition of masses and centre of gravity positions to be considered

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
AERODYNAMIC COEFFICIENTS AND DERIVATIVES				
2.2.2.18	203	10	3.4.17	Basis of aerodynamic coefficients and derivatives
2.2.2.19	203	L0	S3/L0	References
2.2.2.20	203	L1	S3/L9	Asymmetric manoeuvres - Yawing, sideslipping and rolling motions
2.2.2.21	203	L2	S3/L10	Asymmetric manoeuvres - The calculation of the loads associated with asymmetric manoeuvres for aeroplanes having control system with load limiting devices
2.2.3 Gust Loads				
2.2.3.1	204	1	3.5.1	Applicability
GENERAL				
2.2.3.2	204	1	3.5.2	General requirement
FACTORS				
2.2.3.3	204	2	3.5.3	Definition of design and ultimate factors for gust cases
DESIGN CONDITIONS				
2.2.3.4	204	3	3.5.4	Conditions under which strength must be demonstrated
2.2.3.5	204	3	3.5.5	Case for aircraft fitted with terrain following radar
DISCRETE GUST CASES				
2.2.3.6	204	4	3.5.6	Agreement regarding gust velocities to be used
SUBSONIC FLIGHT				
2.2.3.7	204	4	3.5.7	Gust velocities for subsonic flight
GUST LOADS THROUGHOUT THE SPEED RANGE				
2.2.3.8	204	4	3.5.8	Requirements for determining gust loads throughout the envelope
DESIGN ANALYSIS				
2.2.3.9	204	5	3.5.9	Requirement for dynamic analysis
2.2.3.10	204	5	3.5.10	Determination of effects of structural flexibility on stress
2.2.3.11	204	L0	S3/L0	References
2.2.3.12	204	L1	S3/L11	Gust loads - Safe speeds for aeroplanes flying in turbulent weather
2.2.3.13	204	L2	S3/L12	Gust loads - A method of calculating gust loads for preliminary design purposes
2.2.4 Spinning And Spin Recovery				
2.2.4.1	207	1	3.8.1	Scope of requirements
STRENGTH REQUIREMENTS				
FACTORS				
2.2.4.2	207	2	3.8.2	Requirements for ultimate and proof factors
DESIGN CONDITIONS				
2.2.4.3	207	2	3.8.3	Spinning conditions for design calculations
2.2.4.4	207	2	3.8.4	Full scale spinning tests
ASSOCIATED CONDITIONS				
2.2.4.5	207	2	3.8.5	Engine conditions in departure phase
2.2.4.6	207	2	3.8.6	Engine conditions in other phases
2.2.4.7	207	2	3.8.7	Conditions for aeroplanes with external stores
2.3 Specific Structures				
2.3.1 High Lift Devices And Airbrakes				
2.3.1.1	205	1	3.6.1	Scope of the requirements

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
FACTORS				
2.3.1.2	205	2	3.6.2	Requirements for ultimate and proof factors
HIGH LIFT DEVICES				
OPERATION DURING TAKE-OFF, APPROACH AND LANDING				
2.3.1.3	205	3	3.6.4	Capability of operating mechanisms for high lift devices
OPERATION EN-ROUTE OR IN COMBAT				
2.3.1.4	205	3	3.6.5	Capability of operating mechanisms under specified conditions
RAISING SPEED				
2.3.1.5	205	3	3.6.6	Prevention of excessive sinking when flaps are being retracted
DESIGN AND LIMITING SPEEDS				
2.3.1.6	205	3	3.6.7	Design range to allow for speed variations
2.3.1.7	205	3	3.6.8	Lower limits on design speed
STRENGTH				
2.3.1.8	205	3	3.6.9	Strength requirements when high lift devices are retracted
2.3.1.9	205	3	3.6.10	Load cases when high lift devices used for takeoff, approach and landing
2.3.1.10	205	3	3.6.11	Engine conditions for all phases of flight
2.3.1.11	205	3	3.6.12	Gust, manoeuvre and other additional load considerations
2.3.1.12	205	3	3.6.13	Load cases for high lift devices used en-route or in combat
MECHANICAL INTERCONNECTION				
2.3.1.13	205	3	3.6.14	Requirement for synchronised deployment
2.3.1.14	205	3	3.6.15	Proof and ultimate factors arising from failure
2.3.1.15	205	3	3.6.16	Strength of interconnection under asymmetric engine operations
CIRCUIT STIFFNESS				
2.3.1.16	205	3	3.6.17	Limits on differential deployment due to circuit flexibility
AIRBRAKES				
2.3.1.17	205	4	3.6.18	Time requirements for extension and retraction
2.3.1.18	205	4	3.6.19	Conditions for safe operation
STRENGTH				
2.3.1.19	205	4	3.6.20	Strength requirements
MECHANICAL INTERCONNECTIONS				
2.3.1.20	205	4	3.6.21	Proof and ultimate factors on critical interconnections
2.3.2 Active Control Systems				
2.3.2.1	208	1	3.10.1	Scope
GENERAL REQUIREMENTS				
INTEGRATED SYSTEMS				
2.3.2.2	208	1	3.10.2	Effects of associated systems on integrity of full-time ACS
APPLICATIONS				
2.3.2.3	208	1	3.10.3	Aim of full-time ACS
FUNCTIONAL REQUIREMENTS				
2.3.2.4	208	1	3.10.4	Performance requirements
AIRFRAME ASPECTS				
GENERAL				
2.3.2.5	208	4	3.10.54	Guidance regarding interaction between airframe and ACS design

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
STRUCTURAL IMPLICATIONS				
2.3.2.6	208	4	3.10.55	Factors for consideration when determining structural integrity
2.3.2.7	208	4	3.10.56	Limit load cases following ACS failure
2.3.2.8	208	4	3.10.57	Failure warning system
INTEGRITY OF THE ACTIVE CONTROL SYSTEM				
2.3.2.9	208	4	3.10.58	Structural weight/reliability considerations
DESIGN CASES				
2.3.2.10	208	4	3.10.59	Principles for deriving critical design load cases
LOADS MEASUREMENT				
2.3.2.11	208	4	3.10.60	Requirements for prototype, development and preproduction aeroplanes
2.3.2.12	208	4	3.10.61	Requirements for in-service aeroplanes
MODIFICATIONS TO SOFTWARE AND HARDWARE				
2.3.2.13	208	4	3.10.62	Requirements for approval of changes to ACS software or hardware
APPLICATIONS				
INTRODUCTION				
2.3.2.14	208	7	3.10.94	Saturation characteristics of flight critical systems
2.3.2.15	208	7	3.10.95	Compatibility of systems
2.3.2.16	208	7	3.10.96	Requirements for systems which allow selection of the control mode
2.3.2.17	208	7	3.10.97	Provision for pilot override
ACTIVE FLUTTER CONTROL (AFC)				
2.3.2.18	208	7	3.10.98	Aim of the system
2.3.2.19	208	7	3.10.99	Requirement to recover following failure of AFC
MANOEUVRE LOAD ALLEVIATION (MLA)				
2.3.2.20	208	7	3.10.100	Requirement for effect of MLA on structural integrity
GUST LOAD ALLEVIATION (GLA)				
2.3.2.21	208	7	3.10.101	To be completed
WING CAMBER CONTROL (WCC)				
2.3.2.22	208	7	3.10.102	Recovery requirements
STALL AND SPIN PREVENTION (SSP)				
2.3.2.23	208	7	3.10.103	Determination of post departure and recovery characteristics
STRUCTURAL LOAD LIMITING (SLL)				
2.3.2.24	208	7	3.10.104	Requirement for pilot control
VARIABLE CONFIGURATION CONTROL (VCC)				
2.3.2.25	208	7	3.10.105	Requirement for failsafe reversion to manual control
2.3.2.26	208	7	3.10.106	Presentation of configuration data to pilot
RIDE CONTROL (RC)				
2.3.2.27	208	7	3.10.107	Compliance requirements and guidance on aim of requirement
2.3.2.28	208	L4	S3/L28	Structural implications of ACS
2.3.3 Radomes				
MECHANICAL/REQUIREMENTS				
2.3.3.1	210	1	6.1.31	Constraints on radome shape
2.3.3.2	210	2	6.1.32	Structural requirements
2.3.3.3	210	L0	S6/L0	References
2.3.4 Radio And Radar Installations				
2.3.4.1	708	1	6.1.1	Scope

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RADIO AND RADAR EQUIPMENTS				
2.3.4.2	708	1	6.1.2	Performance of installations
2.3.4.3	708	1	6.1.3	Proof and ultimate factors
AERIAL DESIGN				
2.3.4.4	708	2	6.1.18	Electrical performance considerations
2.3.4.5	708	2	6.1.19	Mechanical performance considerations
AERIAL INSTALLATION ON AN AIRFRAME				
2.3.4.6	708	4	6.1.23	Conductivity considerations for mounting flanges
2.3.4.7	708	4	6.1.24	Weak link in fixed wire aerials
2.3.4.8	708	4	6.1.25	Drainage and prevention of moisture ingress
2.3.4.9	708	4	6.1.26	Aerials through pressure diaphragms
2.3.4.10	708	4	6.1.27	Pressure sealing for aerials
2.3.4.11	708	4	6.1.28	Retractable aerial mountings
2.3.4.12	708	4	6.1.29	Effect of single failure on aerial systems
2.3.4.13	708	4	6.1.30	Interlocks to prevent simultaneous transmissions
RADOMES AND AERIAL FAIRINGS				
MECHANICAL/REQUIREMENTS				
2.3.4.14	708	5	6.1.31	Radome shape
2.3.4.15	708	5	6.1.32	Structural soundness of radomes
2.3.4.16	708	5	6.1.33	Lightning protection of radome fairings
ELECTRICAL REQUIREMENTS				
2.3.4.17	708	5	6.1.34	Transmissivity of radomes
2.3.4.18	708	5	6.1.35	Protection from high energy transmissions
TESTING				
2.3.4.19	708	9	6.1.47	Conduct of flight and ground testing
2.3.4.20	708	L0	S6/L0	References
2.3.5 Armament Installations				
INTRODUCTION				
2.3.5.1	711	1	9.1.1	Scope
2.3.5.2	711	1	9.1.2	Approval requirements
2.3.5.3	711	1	9.1.3	Safety and reliability with cameras, tone control and training aids
GENERAL SAFETY AND RELIABILITY				
STRENGTH & ENVRONMENTAL CONDITIONS				
2.3.5.4	711	3	9.1.9	Strength and stiffness requirements
2.3.5.5	711	3	9.1.10	Function of armament system under defined environment
OPERATION OF WEAPON BAY DOORS				
2.3.5.6	711	15	9.1.60	Considerations to allow operation of weapon bay doors
INSTALLATION				
2.3.5.7	711	20	9.1.4	Prevention of fouling and safety from single failure
2.3.6 Pressure Cabins				
2.3.6.1	716	1	3.7.1	Scope
DIFFERENTIAL PRESSURE REQUIREMENTS				
DEFINITIONS				
2.3.6.2	716	2	3.7.2	Definition of low and high pressure differential systems

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LOW DIFFERENTIAL PRESSURE SYSTEMS				
2.3.6.3	716	2	3.7.3	Pressure requirements
2.3.6.4	716	2	3.7.4	Tolerance on pressure level
HIGH DIFFERENTIAL PRESSURE SYSTEMS				
2.3.6.5	716	2	3.7.5	Pressure differential requirements
2.3.6.6	-	-	3.7.6	Capability for crew selection of pressure altitude
2.3.6.7	-	-	3.7.7	Tolerance on pressure level
2.3.6.8	-	-	3.7.8	Rate of change of pressure level
TEST CONNECTIONS				
2.3.6.9	716	10	3.7.35	Use of standard connections
STRENGTH OF PRESSURE CABIN				
2.3.6.10	716	11	3.7.36	Two pressures to be considered
2.3.6.11	716	11	3.7.37	Proof and ultimate factors for defined loads
2.3.6.12	716	11	3.7.38	Proof and ultimate factors for alternate defined loads
STATIC STRENGTH OF PRESSURISATION SYSTEM				
2.3.6.13	716	13	3.7.40	Proof and ultimate factors for components, pipes and ducting
2.3.6.14	716	13	3.7.41	Proof and ultimate factors following blockage by component failure
PROVING TEST				
2.3.6.15	716	14	3.7.42	All cabins to be proof tested before delivery
STATIC TEST				
2.3.6.16	716	14	3.7.43	Tests to support design calculations
2.3.6.17	716	14	3.7.44	Test to support design calculations for components
2.3.6.18	716	L1	S3/L13	Pressure cabins - Strength testing
2.4 Flight Testing				
2.4.1 General Flight Test Requirements - Systems And Structures				
2.4.1.1	1000	1	1.2.1	Scope
2.4.1.2	1000	2	Deleted	
APPLICABILITY				
2.4.1.3	1000	3	1.2.2	Applicability of tests
2.4.1.4	1000	3	1.2.3	Standard of systems
LOADING				
2.4.1.5	1000	5	1.2.7	Loading and centre of gravity requirements for tests
GENERAL TEST CONDITIONS				
2.4.1.6	1000	6	1.2.8	Location of specifications for each test clause
TESTS				
2.4.1.7	1000	7	1.2.9	Responsibility for conducting flight tests
2.4.1.8	1000	7	1.2.10	Specification of limitations prior to flight testing
2.4.2 Structures				
FLIGHT TESTING				
2.4.2.1	1015	1	3.1.17	Scope
BASIC REQUIREMENTS				
2.4.2.2	1015	2	3.1.18	Agreement on scope of load measurement programme
2.4.2.3	1015	2	3.1.19	Co-ordination of load measurement programme
APPLICABILITY				
2.4.2.4	1015	3	3.1.20	Type of aeroplane on which tests are to be conducted

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
TEST REQUIREMENTS				
2.4.2.5	1015	4	3.1.21	Required measurements and conditions
2.4.2.6	1015	4	3.1.22	Demonstration of structural strength
MEASUREMENTS				
2.4.2.7	1015	5	3.1.23	Number and location of measurement points
2.4.2.8	1015	5	3.1.24	Temperature measurement
2.4.2.9	1015	5	3.1.25	Measurement of aeroelastic distortion and modes of vibration
2.4.2.10	1015	5	3.1.26	Recording of flight parameters
FLIGHT LIMITATIONS AND THE RELATION BETWEEN STATIC STRENGTH TESTS AND FLIGHT TESTS				
2.4.2.11	1015	6	3.1.27	Phasing of flight and static strength programmes
2.4.2.12	1015	6	3.1.28	Limitations for flight testing developmental aeroplanes
2.4.2.13	1015	6	3.1.29	Adjustment of ground testing on basis of flight test measurements
2.4.2.14	1015	6	3.1.30	Incorporation of structural alterations fund necessary from static tests
2.4.2.15	1015	6	3.1.31	Timing of tests required in 3.1.22
2.4.2.16	1015	L1	S3/L6	General information

3. PROOF OF STRUCTURE - DAMAGE/FATIGUE TOLERANCE

Aim: To ensure that the structure can withstand the effects of repeated loading for the design service life.

Compliance: Typically by the validation of a no-flaw-growth approach. This may be done by test, analysis or experience with similar designs. The effects of environment, damage, loading and inspection shall be addressed. Validated analytical techniques may be used to reduce the extent of testing.

3.1 General Requirements

3.1.1 Fatigue Damage Tolerance

3.1.1.1	201	1	Nil	Introduction
	201	2	Nil	Safe-life details
	201	3	Nil	Inspection-dependant details
	201	4	Nil	Service monitoring
	201	5	Nil	Demonstration of compliance
	201	6	Nil	Compliance of aeroplanes not designed to DEF STAN 00-970
	201	7	Nil	Definitions
3.1.1.2	Nil	Nil	3.2.1	Scope
APPROACH				
3.1.1.3	Nil	Nil	3.2.2	Acceptable tolerance to damage and defects
3.1.1.4	Nil	Nil	3.2.3	Acceptable safe life
3.1.1.5	Nil	Nil	3.2.4	Exclusions to safe life approach
3.1.1.6	Nil	Nil	3.2.4	Requirements for residual strength
3.1.1.7	Nil	Nil	3.2.5	Account for effects of changes in service temperature
3.1.1.8	Nil	Nil	3.2.6	Provision of means of accounting for consumed fatigue life
3.1.1.9	Nil	Nil	3.2.7	Preparation and maintenance of fatigue type record
MATERIAL SELECTION				
3.1.1.10	Nil	Nil	3.2.8	Substantiation to account for variation in defined properties
3.1.1.11	Nil	Nil	3.2.9	Material selection criteria
3.1.1.12	Nil	Nil	3.2.10	Requirements for structures and assemblies

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
SAFE LIFE SUBSTANTIATION				
3.1.1.13	Nil	Nil	3.2.11	Safe life demonstration using design spectrum
3.1.1.14	Nil	Nil	3.2.12	Recording of evidence supporting the safe life
3.1.1.15	Nil	Nil	3.2.13	Pre-production testing
3.1.1.16	Nil	Nil	3.2.14	Testing of production standard structures using the service spectrum
RESIDUAL STRENGTH				
3.1.1.17	Nil	Nil	3.2.15	Demonstration of residual strength following fatigue testing
3.1.1.18	Nil	Nil	3.2.16	Tear down inspection of built up structure
INSPECTION-BASED SUBSTANTIATION				
3.1.1.19	Nil	Nil	3.2.17	Minimum required safe life of inspection dependent components
3.1.1.20	Nil	Nil	3.2.18	Recording of evidence supporting safe life
3.1.1.21	Nil	Nil	3.2.19	Supporting evidence for inspection periodicity
3.1.1.22	Nil	Nil	3.2.20	Effect of structurally acceptable cracks on vital services
SERVICE MONITORING				
3.1.1.23	Nil	Nil	3.2.21	Provision of instrumentation to estimate fatigue life consumption
3.1.1.24	Nil	Nil	3.2.22	Requirement for additional instrumentation
FATIGUE LOAD METER INSTALLATIONS				
3.1.1.25	Nil	Nil	3.2.23	Previous location of this requirement
GENERAL REQUIREMENTS				
3.1.1.26	Nil	Nil	3.2.24	Provision for fatigue load meter on every aeroplane
INSTALLATION OF RAE FATIGUE LOAD METERS				
3.1.1.27	Nil	Nil	3.2.25	Location of meter
3.1.1.28	Nil	Nil	3.2.26	Position of counter display
SWITCHING ON AND OFF				
3.1.1.29	Nil	Nil	3.2.27	Automatic starting and stopping
RELIABILITY				
3.1.1.30	Nil	Nil	3.2.28	Acceptable failure rate for fatigue meter system
3.1.1.31	201	L1	Nil	
3.1.1.32	201	L2	S3/L34	Fatigue - Material selection
3.1.1.33	201	L3	S3/L35	Fatigue - Safe-life substantiation
3.1.1.34	201	L4	S3/L36	Fatigue - Inspection-based substantiation
3.1.1.35	201	L5	S3/L37	Fatigue - Testing
3.1.1.36	201	L6	S3/L38	Fatigue - Service monitoring
3.1.1.37	201	L7	S3/L39	Fatigue - Life extension
3.1.1.38	201	L8	Nil	
3.1.1.39	Nil	Nil	S3/L40	Fatigue - Fibre-composite components
3.1.1.40	Nil	Nil	S3/L41	Fatigue load meter installations- General considerations
3.1.2 Processes And Working Of Materials				
3.1.2.1	402	4	4.6.6	Need for flaw detection
3.2 Specific Structures				
3.2.1 Radomes				
3.2.1.1	210	1	6.1.31	Radome shape
3.2.1.2	210	2	6.1.32	Structural soundness of radomes
3.2.1.3	210	L0	S6/L0	References

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
3.2.2 Pressure Cabins				
3.2.2.1	716	12	3.7.39	Requirement to conduct fatigue analysis
FATIGUE TEST				
3.2.2.2	716	14	3.7.45	Fatigue test of pressure cabin
3.2.2.3	716	14	3.7.46	Fatigue test of pressurisation systems
3.2.2.4	716	L1	S3/L13	Pressure cabins - Strength testing
3.3 Flight Testing				
3.3.1 General Flight Test Requirements - Systems And Structures				
3.3.1.1	1000	7	1.2.9	Responsibility for conducting flight tests
3.3.1.2	1000	7	1.2.10	Specification of limitations prior to flight testing
3.3.2 Structures				
FLIGHT TESTING				
3.3.2.1	1015	1	3.1.17	Scope
BASIC REQUIREMENTS				
3.3.2.2	1015	2	3.1.18	Agreement on scope of load measurement programme
3.3.2.3	1015	2	3.1.19	Co-ordination of load measurement programme
APPLICABILITY				
3.3.2.4	1015	3	3.1.20	Type of aeroplane on which tests are to be conducted
TEST REQUIREMENTS				
3.3.2.5	1015	4	3.1.21	Required measurements and conditions
3.3.2.6	1015	4	3.1.22	Demonstration of structural strength
MEASUREMENTS				
3.3.2.7	1015	5	3.1.23	Number and location of measurement points
3.3.2.8	1015	5	3.1.24	Temperature measurement
3.3.2.9	1015	5	3.1.25	Measurement of aeroelastic distortion and modes of vibration
3.3.2.10	1015	5	3.1.26	Recording of flight parameters
FLIGHT LIMITATIONS AND THE RELATION BETWEEN STATIC STRENGTH TESTS AND FLIGHT TESTS				
3.3.2.11	1015	6	3.1.27	Phasing of flight and static strength programmes
3.3.2.12	1015	6	3.1.28	Limitations for flight testing developmental aeroplanes
3.3.2.13	1015	6	3.1.29	Adjustment of ground testing on basis of flight test measurements
3.3.2.14	1015	6	3.1.30	Incorporation of structural alterations fund necessary from static tests
3.3.2.15	1015	6	3.1.31	Timing of tests required in 3.1.22
3.3.2.16	1015	L1	S3/L6	Structures - General information
4. PROOF OF STRUCTURE - FLUTTER				
Aim:	To ensure that the structure does not suffer from flutter or other deleterious aeroelastic mechanisms during service.			
Compliance:	Typically by analysis supported by tests or by test at the coupon, element or subcomponent level. The effect of repeated loading and environmental exposure on stiffness, mass and damping properties should be considered.			
4.1 General Requirements				
4.1.1 Aero-Elasticity				
4.1.1.1	500	1	4.8.1	Scope

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
EFFECT OF STRUCTURAL DISTORTION ON THE LOADS ON THE AEROPLANE				
4.1.1.2	500	2	4.8.2	Allowance for aeroplane flexibility in Section 3 calculations
EFFECT OF STRUCTURAL DISTORTION ON THE STABILITY AND CONTROL OF THE AEROPLANE				
4.1.1.3	500	3	4.8.3	Allowance for aeroplane flexibility in Section 2 & 6.5 calculations
FLUTTER				
4.1.1.4	500	4	4.8.4	Freedom from flutter
STATE OF THE AEROPLANE				
MASS DISTRIBUTION AND STRUCTURE				
4.1.1.5	500	5	4.8.5	Conditions under which 4.8.[2-4] are to be met
SYSTEMS				
4.1.1.6	500	5	4.8.6	Condition of systems under which 4.8.[2-4] are to be met
EFFECT OF FAILURES				
STRUCTURE				
4.1.1.7	500	6	4.8.7	Conditions under which 4.8.[2-4] are to be met for damage tolerant structure
SYSTEMS				
4.1.1.8	500	6	4.8.8	Conditions under which 4.8.4 are to be met for failed systems
DEMONSTRATION OF COMPLIANCE				
4.1.1.9	500	7	4.8.9	Calculations and tests to demonstrate compliance with 4.8.4
4.1.1.10	500	L1	S4/L23	Aero-elasticity - Flutter clearance programme
4.1.1.11	500	L2	S4/L24	Aero-elasticity - Main surface flutter
4.1.1.12	500	L3	S4/L25	Aero-elasticity - Flutter of control surfaces (ailerons, elevators and rudders)
4.1.1.13	500	L6	S4/L28	Aero-elasticity - Stiffness tests
4.1.2 Active Control Systems				
4.1.2.1	208	1	3.10.1	Scope
GENERAL REQUIREMENTS				
INTEGRATED SYSTEMS				
4.1.2.2	208	1	3.10.2	Effects of associated systems on integrity of full-time ACS
APPLICATIONS				
4.1.2.3	208	1	3.10.3	Aim of full-time ACS
FUNCTIONAL REQUIREMENTS				
4.1.2.4	208	1	3.10.4	Performance requirements
AIRFRAME ASPECTS				
GENERAL				
4.1.2.5	208	4	3.10.54	Guidance regarding interaction between airframe and ACS design
STRUCTURAL IMPLICATIONS				
4.1.2.6	208	4	3.10.55	Factors for consideration when determining structural integrity
4.1.2.7	208	4	3.10.56	Limit load cases following ACS failure
4.1.2.8	208	4	3.10.57	Failure warning system
INTEGRITY OF THE ACTIVE CONTROL SYSTEM				
4.1.2.9	208	4	3.10.58	Structural weight versus reliability of ACS considerations
DESIGN CASES				
4.1.2.10	208	4	3.10.59	Principles for deriving critical design load cases

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
LOADS MEASUREMENT				
4.1.2.11	208	4	3.10.60	Requirements for prototype, development and preproduction aeroplanes
4.1.2.12	208	4	3.10.61	Requirements for in-service aeroplanes
MODIFICATIONS TO SOFTWARE AND HARDWARE				
4.1.2.13	208	4	3.10.62	Requirements for approval of changes to ACS software or hardware
APPLICATIONS				
INTRODUCTION				
4.1.2.14	208	7	3.10.94	Saturation characteristics of flight critical systems
4.1.2.15	208	7	3.10.95	Compatibility of systems
4.1.2.16	208	7	3.10.96	Requirements for systems which allow selection of the control mode
4.1.2.17	208	7	3.10.97	Provision for pilot override
ACTIVE FLUTTER CONTROL (AFC)				
4.1.2.18	208	7	3.10.98	Aim of the system
4.1.2.19	208	7	3.10.99	Requirement to recover following failure of AFC
MANOEUVRE LOAD ALLEVIATION (MLA)				
4.1.2.20	208	7	3.10.100	Requirement for effect of MLA on structural integrity
GUST LOAD ALLEVIATION (GLA)				
4.1.2.21	208	7	3.10.101	To be completed
WING CAMBER CONTROL (WCC)				
4.1.2.22	208	7	3.10.102	Recovery requirements
STALL AND SPIN PREVENTION (SSP)				
4.1.2.23	208	7	3.10.103	Determination of post departure and recovery characteristics
STRUCTURAL LOAD LIMITING (SLL)				
4.1.2.24	208	7	3.10.104	Requirement for pilot control
VARIABLE CONFIGURATION CONTROL (VCC)				
4.1.2.25	208	7	3.10.105	Requirement for failsafe reversion to manual control
4.1.2.26	208	7	3.10.106	Presentation of configuration data to pilot
RIDE CONTROL (RC)				
4.1.2.27	208	7	3.10.107	Compliance requirements and guidance on aim of requirement
4.1.2.28	208	L4	S3/L28	Active control systems - Structural implications of ACS
4.2 Specific Structures				
4.2.1 Radio And Radar Installations				
AERIAL DESIGN				
4.2.1.1	708	2	6.1.18	Electrical performance considerations
4.2.1.2	708	2	6.1.19	Mechanical performance considerations
TESTING				
4.2.1.3	708	9	6.1.47	Conduct of flight and ground testing
4.2.1.4	708	L0	S6/L0	References
4.3 Flight Testing				
4.3.1 General Flight Test Requirements - Systems And Structures				
4.3.1.1	1000	1	1.2.1	Scope
4.3.1.2	1000	2	Deleted	
APPLICABILITY				
4.3.1.3	1000	3	1.2.2	Applicability of tests
4.3.1.4	1000	3	1.2.3	Standard of systems

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
LOADING				
4.3.1.5	1000	5	1.2.7	Loading and centre of gravity requirements for tests
GENERAL TEST CONDITIONS				
4.3.1.6	1000	6	1.2.8	Location of specifications for each test clause
TESTS				
4.3.1.7	1000	7	1.2.9	Responsibility for conducting flight tests
4.3.1.8	1000	7	1.2.10	Specification of limitations prior to flight testing
4.3.2 Flutter And Vibration				
4.3.2.1	1016	1	4.8.1	Scope
FLUTTER AND VIBRATION				
4.3.2.2	1016	1	4.8.10	Purpose of flight flutter tests and flight vibration study
FLIGHT FLUTTER TESTING				
4.3.2.3	1016	2	4.8.11	Sequence of flight testing
FLIGHT VIBRATION STUDY				
4.3.2.4	1016	2	4.8.12	Envelope of the flight vibration study
4.3.2.5	1016	L1	S4/L32	Flutter and vibration - Fight vibration survey
ADDITIONAL CONSIDERATIONS				
5. IMPACT DYNAMICS				
Aim:	To assure that occupants have every reasonable chance of escaping serious injury under realistic and survival impact conditions.			
Compliance:	By test or by analysis supported by test. Validated analytical techniques may be used to reduce the extent of testing.			
5.1 General Requirements				
5.1.1 Reduction Of Vulnerability To Battle Damage				
INTRODUCTION				
5.1.1.1	112	1	9.9.1	Purpose of the clause
5.1.1.2	112	1	9.9.2	Location of background information
5.1.1.3	112	1	9.9.3	Data regarding defined threat events
5.1.1.4	112	2	9.9.5	Location of definitions
DESIGN				
5.1.1.5	112	3	9.9.6	Degradation due to single threat events
VULNERABILITY ANALYSIS				
5.1.1.6	112	4	9.9.7	Method to determine vulnerability standards
BATTLE DAMAGE REPAIR				
5.1.1.7	112	5	9.9.8	Consideration and provision for battle damage repair
5.1.1.8	112	L1	S9/L22	Reduction of vulnerability to battle damage - General requirements
5.1.2 Protection of Aircrews Against Conventional Weapons				
GENERAL				
5.1.2.1	114	1	9.10.1	Requirements
5.1.2.2	114	1	9.10.2	Scope

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
DESIGN				
5.1.2.3	114	2	9.10.3	Shielding of crew by structure
5.1.2.4	114	2	9.10.4	Separation of multiple pilot stations
5.1.2.5	114	2	9.10.5	Mobility and vision restrictions
5.1.2.6	114	2	9.10.6	Interference during exit, escape and crash landing
5.1.2.7	114	2	9.10.7	Selection of materials
5.1.2.8	114	2	9.10.8	Requirement for Casualty Reduction Analysis
ARMOUR				
5.1.2.9	114	3	9.10.9	Requirements for armour
REDUCTION OF VULNERABILITY TO BATTLE DAMAGE				
5.1.2.10	114	4	9.10.10	Notification of required protective equipment
5.1.2.11	114	L1	S9/L23	Protection of aircrew against conventional weapons - General requirements
5.1.3 Airframe Design To Resist Birdstrike Damage				
5.1.3.1	209	1	4.9.1	Scope
BASIC OPERATIONAL REQUIREMENTS				
FLYING QUALITIES				
5.1.3.2	209	2	4.9.3	Degradation of flight due to single birdstrike
THE THREAT				
5.1.3.3	209	3	4.9.4	Broad description of threat
5.1.3.4	209	3	4.9.5	Location of birdstrike
DETAILED REQUIREMENTS				
TRANSPARENCIES AND THEIR SUPPORTING STRUCTURE				
5.1.3.5	209	4	4.9.6	Requirements for transparencies for defined impacts
5.1.3.6	209	4	4.9.7	Requirements for transparency support structure for defined impacts
FRONT FUSELAGE				
5.1.3.7	209	4	4.9.8	Requirements for front fuselage for defined impacts
ENGINE AIR INTAKES				
5.1.3.8	209	4	4.9.9	Requirements for engine air intakes for defined impacts
FRONTAL ASPECTS OF FLYING SURFACES				
5.1.3.9	209	4	4.9.10	Requirements for frontal aspects of flying surfaces for defined impacts
AERODYNAMIC DEVICES ON LEADING EDGES OF FLYING SURFACES				
5.1.3.10	209	4	4.9.11	Consideration of effects of birdstrike on forward facing aerodynamic devices
SYSTEMS				
5.1.3.11	209	4	4.9.12	Requirements for systems dor defined impacts
GENERAL				
5.1.3.12	209	5	4.9.2	Establishing mode and extent of testing
5.1.4 Crash Landing, Ditching and Precautionary Alighting on Water				
5.1.4.1	307	1	4.22.1	Category of aeroplane and purpose of requirements
GENERAL				
5.1.4.2	307	1	4.22.2	Overall design approach

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DESIGN FOR CRASH LANDING, DITCHING AND PRECAUTIONARY ALIGHTING ON WATER				
EVACUATION				
5.1.4.3	307	2	4.22.3	Time and available exit limits for evacuation
5.1.4.4	307	2	4.22.4	Means of opening emergency exits
5.1.4.5	307	2	4.22.5	Continued functioning of required systems
5.1.4.6	307	2	4.22.6	Strength requirements for structure controlling use of emergency exits
5.1.4.7	307	2	4.22.7	Interference from seats, stretchers and their support structure
5.1.4.8	307	2	4.22.8	Crashworthiness of defined items
PROTECTIVE SHELL				
5.1.4.9	307	2	4.22.9	Prevention of buckling of crew and passenger compartments
5.1.4.10	307	2	4.22.10	Design of interior of protective shell to minimise injury
5.1.4.11	307	2	4.22.11	Design to prevent entrapment
5.1.4.12	307	2	4.22.12	Movement of parts near occupants
5.1.4.13	307	2	4.22.13	Prevention of ceiling collapse
STRENGTH AND ENERGY ABSORPTION				
5.1.4.14	307	2	4.22.14	Mass condition for strength requirements
5.1.4.15	307	2	4.22.15	Requirements for acceleration of crew upon defined impacts
5.1.4.16	307	2	4.22.16	Minimum ultimate factors for defined conditions
MATERIALS				
5.1.4.17	307	2	4.22.17	Considerations for composite materials
5.1.4.18	307	2	4.22.18	Considerations for materials that may contact the ground in a crash
5.1.4.19	307	2	4.22.19	Consideration of resistance to burning and requirement of 4.26
CONTROLS				
5.1.4.20	307	2	4.22.20	Prevention of hazard to crew
DESIGN FOR DITCHING AND PRECAUTIONARY ALIGHTING ON WATER				
GENERAL				
5.1.4.21	307	3	4.22.21	Estimation of velocity and acceleration ellipsoids
5.1.4.22	307	3	4.22.22	Controlled fuel jettison
FLOTATION				
5.1.4.23	307	3	4.22.23	Requirement to remain afloat
5.1.4.24	307	3	4.22.24	Requirement to remain afloat with failures in flotation aids
ESCAPE				
5.1.4.25	307	3	4.22.25	Requirement to withstand local pressures upon contact with water
5.1.4.26	307	3	4.22.26	Design for salvage of equipment, deployment and entry to liferafts
5.1.4.27	307	3	4.22.27	Provision of external and internal release of liferafts
DESIGN FOR CRASH LANDING				
GENERAL				
5.1.4.28	307	4	4.22.28	Additional requirements for category B aeroplanes
DESIGN FOR LONGITUDINAL IMPACT				
5.1.4.29	307	4	4.22.29	Case 1
5.1.4.30	307	4	4.22.30	Case 2
5.1.4.31	307	4	4.22.31	Case 3
DESIGN FOR VERTICAL IMPACT				
5.1.4.32	307	4	4.22.32	Case 1
5.1.4.33	307	4	4.22.33	Case 2
5.1.4.34	307	4	4.22.34	Case 3

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
DESIGN FOR LATERAL IMPACT				
5.1.4.35	307	4	4.22.35	Requirement for lateral impact
COMBINED CASES				
5.1.4.36	307	4	4.22.36	Case 1
5.1.4.37	307	4	4.22.37	Case 2
ROLL-OVER				
5.1.4.38	307	4	4.22.38	Case 1
5.1.4.39	307	4	4.22.39	Case 2
5.1.4.40	307	4	4.22.40	Case 3
5.1.4.41	307	4	4.22.41	Defined mass for Case 1 and Case 2
SEAT INSTALLATION - CREW AND SPECIFIED OCCUPANTS				
5.1.4.42	307	4	4.22.42	Requirements for seat installations
SEAT INSTALLATION - OTHER OCCUPANTS				
5.1.4.43	307	4	4.22.43	Requirements for seat installations for other occupants
EQUIPMENT AND COMPONENTS OF SYSTEMS				
5.1.4.44	307	4	4.22.44	Restraint of equipment and components
5.1.4.45	307	4	4.22.45	Defined equipment also to meet 4.22.44
5.1.4.46	307	4	4.22.46	Requirements for stowage spaces
5.1.4.47	307	4	4.22.47	Load factors for installations where 4.22.[44-45] do not apply
CARGO AND FREIGHT				
5.1.4.48	307	4	4.22.48	Requirements for support and energy absorption
5.1.4.49	307	4	4.22.49	Static strength requirements
MOUNTINGS OF MASSIVE PARTS				
5.1.4.50	307	4	4.22.50	Normal and special flight case for massive parts
5.1.4.51	307	4	4.22.51	Additional requirements for parts in crash landing or ditching
STRETCHERS (LITTERS)				
5.1.4.52	307	4	4.22.52	Static strength requirements for crash landing and ditching
HAND GRIPS				
5.1.4.53	307	4	4.22.53	Ultimate factor for hand grips
HARNESS ATTACHMENT				
5.1.4.54	307	4	4.22.54	Allowances for seat movement when harness attached to structure
EVACUATION				
5.1.4.55	307	4	4.22.55	Requirements for emergency exits and related structure
5.1.4.56	307	4	4.22.56	Crashworthiness of lighting, escape identifications and markings
DESIGN OF SYSTEMS				
GENERAL				
5.1.4.57	307	5	4.22.57	Minimise probability of fire by meeting requirements of 4.26
5.1.4.58	307	5	4.22.58	All components to meet 4.22.44 or 4.2.47 as appropriate
FUEL SYSTEM				
5.1.4.59	307	5	4.22.59	Design to contain fuel during and after the crash
5.1.4.60	307	5	4.22.60	Requirements for fuel tanks
VALIDATION OF DESIGN				
5.1.4.61	307	6	4.22.61	Demonstration of compliance of 4.22.[1-60]
5.1.4.62	307	6	4.22.62	Consideration of models and dynamic tests
5.1.4.63	307	6	4.22.63	Proper function when individual crashworthy elements are combined
5.1.4.64	307	6	4.22.64	Test program for ditching or precautionary alighting on water
5.1.4.65	307	6	4.22.65	Sled testing of defined structure

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RELIABILITY				
5.1.4.66	307	7	4.22.66	Requirement for reliability tests
APPLICABILITY OF TABLES				
TABLES 30 TO 37				
5.1.4.67	307	8	4.22.67	As appropriate for A and C but mandatory for new Cat. B aeroplanes
TABLE 38				
5.1.4.68	307	8	4.22.68	Meteorological data
TABLES 39 TO 42				
5.1.4.69	307	8	4.22.69	All categories where full standard of 4.22.[1-60] is not required
5.1.4.70	307	L0	S4/L0	References
5.1.4.71	307	L1	Part 0	Procedures for use, content and definitions
5.1.4.72	307	L2	S4/L75	Crash landing, ditching and precautionary alighting on water - Design for crash landing and ditching
5.1.5 General Detail Design				
5.1.5.1	400	13	4.1.40	Material repairability and resistance to NBC attack
5.1.5.2	400	13	4.1.41	Repairable materials
5.1.5.3	400	13	4.1.42	Response to NBC effects
5.1.5.4	400	L0	S6/L0	References
5.1.6 Ice Protection				
OPERATIONAL REQUIREMENTS				
5.1.6.1	712	2	6.9.2	Requirements for operation under defined conditions
SYSTEM REQUIREMENTS - GENERAL				
5.1.6.2	712	5	6.9.3	Provision of symmetric shedding
5.1.6.3	712	5	6.9.12	Effects of shed ice or slush
DESIGN AND CONSTRUCTION				
5.1.6.4	712	9	6.9.29	Requirements of ice protection system
TESTING				
5.1.6.5	712	9	6.9.37	Quality of ice protection system under test
5.1.7 Protection From The Effects Of Nuclear Explosions, Laser Weapons, Chemical And Biological Warfare Agents				
INTRODUCTION				
5.1.7.1	723	1	9.11.1	Applicability of clauses
5.1.7.2	723	1	9.11.2	Requirements for NBC/laser hardening
5.1.7.3	723	1	9.11.3	Security classification of references
GENERAL				
5.1.7.4	723	2	9.11.4	Operation by personnel in NBC and laser protective clothing
5.1.7.5	723	2	9.11.5	Maintenance, replenishment and rearmament in NBC clothing
NUCLEAR ENVIRONMENT REQUIREMENTS				
GENERAL				
5.1.7.6	723	3	9.11.6	Aim of basis nuclear survivability
DESIGN				
5.1.7.7	723	3	9.11.7	Design objective for nuclear hardening
5.1.7.8	723	3	9.11.8	Principal design aim
5.1.7.9	723	3	9.11.9	Initial feasibility study
5.1.7.10	723	3	9.11.10	Consideration of effects of friendly forces weapons

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
OPERATIONAL CONDITIONS				
5.1.7.11	723	3	9.11.11	Flight and ground conditions at exposure
CHEMICAL AND BIOLOGICAL ENVIRONMENT REQUIREMENTS				
GENERAL				
5.1.7.12	723	4	9.11.12	Determination of level of chemical hardening
DESIGN				
5.1.7.13	723	4	9.11.13	Design objective
5.1.7.14	723	4	9.11.14	Principal design aim
5.1.7.15	723	4	9.11.15	Repeated operation while contaminated
5.1.7.16	723	4	9.11.16	Design for resistance to attack
5.1.7.17	723	4	9.11.17	Design for handling and decontamination
5.1.7.18	723	4	9.11.18	Requirement for Chemical and Biological survivability feasibility study
5.1.7.19	723	4	9.11.19	Design for prevention of ingress of liquid chemical agents
5.1.7.20	723	4	9.11.20	Design criteria for environmental control system
5.1.7.21	723	4	9.11.21	Use of all weather seals to preclude CW or BW contaminants
5.1.7.22	723	4	9.11.22	Suitable filtration
5.1.7.23	723	4	9.11.23	Requirements for materials liable to contamination
CHEMICAL AND BIOLOGICAL TESTING				
5.1.7.24	723	4	9.11.24	Provision of materials proposed for defined uses
LASER REQUIREMENTS				
GENERAL				
5.1.7.25	723	5	9.11.25	Developments of lasers
5.1.7.26	723	5	9.11.26	Aim for laser survivability
DESIGN				
5.1.7.27	723	5	9.11.27	Design objective for laser hardening
5.1.7.28	723	5	9.11.28	Principal design aim
5.1.7.29	723	5	9.11.29	Conduct laser survivability study during feasibility study stage
5.1.7.30	723	5	9.11.30	Minimisation of damage due to friendly forces
5.1.7.31	723	L0	S9/L0	References
5.1.7.32	723	L1	S9/L24	Protection from the effects of nuclear explosions, laser weapons, chemical and biological warfare agents -Definitions
5.2 Specific Structures				
5.2.1 Radomes				
5.2.1.1	210	1	6.1.31	Radome shape
5.2.1.2	210	2	6.1.32	Structural soundness of radomes
5.2.1.3	210	L0	S6/L0	References
5.2.2 Radio And Radar Installations				
5.2.2.1	708	1	6.1.1	Scope
RADIO AND RADAR EQUIPMENTS				
5.2.2.2	708	1	6.1.2	Performance of installations
5.2.2.3	708	1	6.1.3	Proof and ultimate factors
AERIAL LOCATION ON AN AIRFRAME				
5.2.2.4	708	3	6.1.20	Electrical performance considerations

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
MECHANICAL CONSTRAINTS				
5.2.2.5	708	3	6.1.21	Fail safe design of mechanically deployed aerials
5.2.2.6	708	3	6.1.22	Defined mechanical constraints
RADOMES AND AERIAL FAIRINGS				
MECHANICAL/REQUIREMENTS				
5.2.2.7	708	5	6.1.31	Radome shape
5.2.2.8	708	5	6.1.32	Structural soundness of radomes
5.2.2.9	708	5	6.1.33	Lightning protection of radome fairings
ELECTRICAL REQUIREMENTS				
5.2.2.10	708	5	6.1.34	Transmissivity of radomes
5.2.2.11	708	5	6.1.35	Protection from high energy transmissions
TESTING				
5.2.2.12	708	9	6.1.47	Conduct of flight and ground testing

6. FLAMMABILITY

Aim: To minimise the hazard to occupants if flammable liquids are ignited and for components to withstand exposure to heat, flames or sparks. The use of composites should not reduce the level of safety inherent in conventional metallic structure.

Compliance: By analysis supported by test. A test has been developed for evaluating the flammability of materials that are required to be fire resistant in civilian aircraft (AC 20-107A Section 9. b. (2)).

6.1 General Requirements

6.1.1 Fire Precautions

6.1.1.1	713	1	4.26.1	Scope
GENERAL REQUIREMENTS				
6.1.1.2	713	2	4.26.2	Designation of fire zones
6.1.1.3	713	2	4.26.3	Risk of spontaneous ignition and provision of warning systems
6.1.1.4	713	2	4.26.4	Minimising ignition risk from leakage of flammable fluids
6.1.1.5	713	2	4.26.5	Fire detection and suppression equipment in designated fire zones
6.1.1.6	713	2	4.26.6	Routing of essential flight controls and services
6.1.1.7	713	2	4.26.7	Design of filling points for flammable fluids
6.1.1.8	713	2	4.26.8	Ducting and discharge of cooling air
6.1.1.9	713	2	4.26.9	Design of fire extinguisher system
6.1.1.10	713	2	4.26.10	Electrical cables and terminals in designated fire zones
PRECAUTIONS IN DESIGNATED FIRE ZONES				
6.1.1.11	713	3	4.26.11	Listing of, and requirements for, designated fire zones
6.1.1.12	713	3	4.26.12	Fires in multi-engine aeroplanes
TORCHING FLAMES				
6.1.1.13	713	3	4.26.13	Precaution to protect aeroplane from the effects of torching flames
FLAMMABLE FLUID SYSTEMS				
6.1.1.14	713	3	4.26.14	Proximity of ignition sources to systems carrying flammable fluids
6.1.1.15	713	3	4.26.15	Protection of components carrying flammable fluids
6.1.1.16	713	3	4.26.16	Protection of parts in designated fire zones
6.1.1.17	713	3	4.26.17	Location and protection of flammable fluid tanks
6.1.1.18	713	3	4.26.18	Treatment of absorbent materials near flammable fluid systems

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
DRAINS, VENTS AND VENTILATION				
6.1.1.19	713	3	4.26.19	Drainage requirements for designated fire zones
6.1.1.20	713	3	4.26.20	Ventilation requirements for designated fire zones
FLAMMABLE FLUID SHUT-OFF				
6.1.1.21	713	3	4.26.21	Shut-off of flammable fluids through designated fire zones
FIREWALLS				
6.1.1.22	713	3	4.26.22	Parts that must be isolated by firewalls
6.1.1.23	713	3	4.26.23	Requirements of systems passing through firewalls
FIRE DETECTION AND FIRE WARNING				
6.1.1.24	713	3	4.26.24	Requirements for fire/temperature detectors in designated fire zones
FIRE EXTINCTION				
6.1.1.25	713	3	4.26.25	Location of fire extinguishing systems
6.1.1.26	713	3	4.26.26	Zones that require second discharge of extinguishant
6.1.1.27	713	3	4.26.27	Systems for APU, fuel burning heater and combustion equipment
6.1.1.28	713	3	4.26.28	Operation of main engine power unit extinguisher systems
6.1.1.29	713	3	4.26.29	Operation of fire extinguishing system under crash conditions
6.1.1.30	713	3	4.26.30	Detector to show that extinguishant has been discharged
PRECAUTIONS IN OTHER ZONES				
6.1.1.31	713	4	4.26.31	Cross-reference to clauses for precautions related to combat fires
FLAMMABLE FLUID FIRE PROTECTION				
6.1.1.32	713	4	4.26.32	Minimising probability of ignition of leaked flammable fluids
6.1.1.33	713	4	4.26.33	Means of alerting crew if crew action is required
6.1.1.34	713	4	4.26.34	Identification of areas where flammable fluids may leak
6.1.1.35	713	4	4.26.35	Cross-reference to requirements for fluid drains, vents and ventilation
6.1.1.36	713	4	4.26.36	Location of vent or drainage provision
AREAS ADJACENT TO DESIGNATED FIRE ZONES AND ENGINE NACELLE ATTACHING STRUCTURES				
6.1.1.37	713	4	4.26.37	Cross-reference to requirements for relevant structure
6.1.1.38	713	4	4.26.38	Construction of engine mountings and other critical structure
6.1.1.39	713	4	4.26.39	Requirement for components and structure immediately adjacent to firewalls
6.1.1.40	713	4	4.26.40	Airspace requirements between firewalls and tanks or reservoirs
ELECTRICAL SYSTEM FIRE AND SMOKE PROTECTION				
6.1.1.41	713	6	4.26.46	Requirements for electrical components
6.1.1.42	713	6	4.26.47	Requirements in event of failure of electrical equipment
6.1.1.43	713	6	4.26.48	Electrical equipment that may come into contact with flammable vapours
6.1.1.44	713	6	4.26.49	Flammability requirements for insulated electrical wire and cable
CARGO BAYS				
6.1.1.45	713	8	4.26.56	Location and protection of safety critical parts
6.1.1.46	713	8	4.26.57	Protection of fire-fighting features in compartments
6.1.1.47	713	8	4.26.58	Shielding or insulation of heats sources
6.1.1.48	713	8	4.26.59	Cross-reference to classification of cargo compartments
6.1.1.49	713	8	4.26.60	Requirements for compartments required to contain a fire detection system
PRECAUTIONS: COMBAT INDUCED FIRES				
6.1.1.50	713	11	4.26.71	Design and location of components
6.1.1.51	713	11	4.26.72	Routing of fuel lines
6.1.1.52	713	11	4.26.73	Draining and venting of fuel tanks located above engines

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
COMPARTMENT INTERIORS - TEST CRITERIA				
6.1.1.53	713	12	4.26.74	Cross-reference to requirements for materials used in inhabited compartments
6.1.1.54	713	12	4.26.75	Group #1. Self extinguishing when tested vertically
6.1.1.55	713	12	4.26.76	Group #2. Self extinguishing when tested vertically
6.1.1.56	713	12	4.26.77	Group #3. Defined burn rate when tested horizontally
6.1.1.57	713	12	4.26.78	Other materials
6.1.1.58	713	12	4.26.79	Additional requirements for seat cushions
6.1.1.59	713	L0	S4/L0	References
6.1.1.60	713	L1	Part 0	Procedures for use, content and definitions
6.1.1.61	713	L2	S4/L86	Fire precautions - General recommendations
6.1.1.62	713	L3	S4/L87	Fire precautions - Combat induced fires
6.1.1.63	713	L4	S4/L88	Fire precautions - An acceptable test procedure for showing compliance with Clause 4.26.74-81
6.1.2 Reduction Of Vulnerability To Battle Damage				
INTRODUCTION				
6.1.2.1	112	2	9.9.5	Location of definitions
DESIGN				
6.1.2.2	112	3	9.9.6	Degradation due to single threat events
VULNERABILITY ANALYSIS				
6.1.2.3	112	4	9.9.7	Method to determine vulnerability standards
6.1.2.4	112	L1	S9/L22	Reduction of vulnerability to battle damage - General requirements
6.1.3 Crash Landing, Ditching and Precautionary Alighting on Water				
GENERAL				
6.1.3.1	307	5	4.22.57	Minimise probability of fire by meeting requirements of 4.26
6.1.3.2	307	5	4.22.58	All components to meet 4.22.44 or 4.2.47 as appropriate
FUEL SYSTEM				
6.1.3.3	307	5	4.22.59	Design to contain fuel during and after the crash
6.1.3.4	307	5	4.22.60	Requirements for fuel tanks
7. LIGHTNING PROTECTION				
Aim:	For the structure to dissipate P-static electrical charges and divert the resultant electrical current so as not to endanger the aircraft.			
Compliance:	By analysis supported by test. Consideration shall be given to possible deterioration and undetected damage of the lightning protection system.			
7.1 General Requirements				
7.1.1 Bonding And Screening				
7.1.1.1	709	1	4.27.1	Scope of clauses and purpose of bonding
BONDING				
7.1.1.2	709	3	4.27.7	Bonding requirements for metallic parts of structure and skin
7.1.1.3	709	3	4.27.8	Consideration of bonding for non-metallic parts
7.1.1.4	709	3	4.27.9	Bonding of metallic control and distribution panels
7.1.1.5	709	3	4.27.10	Bonding of the engine

Item	Def Stan 00-970 /1 (AL14) (Part 1) /2			Description
	Chapt	Para	Clause	
CLASS A BONDING (ANTENNA INSTALLATION)				
7.1.1.6	709	3	4.27.11	General requirement for bonding
7.1.1.6	709	3	4.27.12	Bonding of hatches in vicinity of antenna
7.1.1.6	709	3	4.27.13	Circumferential RF continuity
CLASS C BONDING (CURRENT RETURN PATH)				
7.1.1.6	709	3	4.27.14	Adequacy of bond to carry maximum fault current
7.1.1.6	709	3	4.27.15	Bonding in areas where hazardous conditions exist
CLASS H BONDING (SHOCK HAZARD)				
7.1.1.6	709	3	4.27.16	Exposure of paths containing high voltage
CLASS R BONDING (RF POTENTIAL)				
7.1.1.6	709	3	4.27.17	Bonding of equipment that emits electromagnetic energy
7.1.1.6	709	3	4.27.18	Inherent RF bonding within aeroplane design
7.1.1.6	709	3	4.27.19	Bonding of metallic equipment mountings
7.1.1.6	709	3	4.27.20	RF bonding of cable screens and connector shells
CLASS S BONDING (STATIC CHARGE)				
7.1.1.6	709	3	4.27.21	Mechanically secure connections to aeroplane structure
7.1.1.6	709	3	4.27.22	Bonding of metal parts carrying fluids
LIGHTNING STRIKE PROTECTION				
PROTECTION - GENERAL REQUIREMENTS (CLASS L BONDING)				
7.1.1.7	709	4	4.27.23	Incorporation of lightning protection measures through design stage
7.1.1.8	709	4	4.27.24	Use of, and requirements for, primary conductors
7.1.1.9	709	4	4.27.25	Compliance statement for bonding straps and soldered connections
PROTECTION OF STRUCTURE				
7.1.1.10	709	4	4.27.26	Protection requirements for conventional metallic aeroplanes
7.1.1.11	709	4	4.27.27	Consideration of strike plates for non-metallic materials
7.1.1.12	709	4	4.27.28	Consideration for non-metallic structure housing electrical equipment
7.1.1.13	709	4	4.27.29	Protection of transparencies that contain electrical films or elements
7.1.1.14	709	4	4.27.30	Prevention of damage to electrical systems from induced voltages
PROTECTION OF CONTROL SURFACES AND CONTROL SYSTEMS				
7.1.1.15	709	4	4.27.31	Bonding of control surfaces, flaps and any other moving parts
PROTECTION OF PROTRUSIONS AND EXTERNAL PARTS				
7.1.1.16	709	4	4.27.32	Bonding of external electrically isolated conductors
7.1.1.17	709	4	4.27.33	Design of antenna systems for lightning discharge
7.1.1.18	709	4	4.27.34	Consideration of voltage spikes due to strikes on parts connected to electrical system
7.1.1.19	709	4	4.27.33 (error)	Consideration to the protection of large non-conducting projections
PROTECTION OF THE FUEL SYSTEM				
7.1.1.20	709	4	4.27.35	Location and design of fuel vents and jettisoning systems
7.1.1.21	709	4	4.27.36	Consideration of main ground system in design of fuel system
7.1.1.22	709	4	4.27.37	Consideration of integral metallic wing fuel tanks
7.1.1.23	709	4	4.27.38	Metallic parts in non-metallic fuel tanks
LIGHTNING PROTECTION TESTS				
7.1.1.24	709	4	4.27.39	Requirements for high current pulse tests
7.1.1.25	709	L0	S4/L0	References
7.1.1.26	709	L2	S4/L89	Bonding and screening - Bonding of control surfaces
7.1.1.27	709	L3	S4/L90	Bonding and screening - Recommended lightning tests

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
7.1.2 Lightning Strike Protection				
7.1.2.1				ADF TAR requirement - Lightning strike protection Comply with FAA AC 20-107A, Section 9. c.
7.2 Specific Structures				
7.2.1 Radomes				
RADOMES AND AERIAL FAIRINGS				
MECHANICAL/REQUIREMENTS				
7.2.1.1	708	5	6.1.31	Radome shape
7.2.1.2	708	5	6.1.32	Structural soundness of radomes
7.2.1.3	708	L0	S6/L0	References
7.2.2 Radio And Radar Installations				
RADOMES AND AERIAL FAIRINGS				
MECHANICAL/REQUIREMENTS				
7.2.2.1	708	5	6.1.31	Radome shape
7.2.2.2	708	5	6.1.32	Structural soundness of radomes
7.2.2.3	708	5	6.1.33	Lightning protection of radome fairings
ELECTRICAL REQUIREMENTS				
7.2.2.4	708	5	6.1.34	Transmissivity of radomes
7.2.2.5	708	5	6.1.35	Protection from high energy transmissions
TESTING				
7.2.2.6	708	9	6.1.47	Conduct of flight and ground testing
7.2.2.7	708	L0	S6/L0	References
8. PROTECTION OF STRUCTURE				
Aim:	To protect the structure against the effects of weathering, abrasion, erosion, ultraviolet radiation and chemical environment (glycol, hydraulic fluid, fuel, cleaning agents, etc.).			
Compliance:	By test to demonstrate suitable protection against these agents, or consideration of the degradation in material properties resulting from exposure.			
8.1 General Requirements				
8.1.1 General Requirements				
LOOSE ARTICLE HAZARDS - CONTROL SYSTEMS				
8.1.1.1	100	17	1.1.29	Design to prevent generation of loose articles
8.1.1.2	100	17	1.1.30	Preservation of flying qualities in presence of jamming by loose articles
8.1.1.3	100	17	1.1.31	Requirements for guards
PREVENTION OF ACCIDENTAL DAMAGE				
8.1.1.4	100	18	1.1.32	Design for prevention of accidental damage
8.1.2 Operation In Various Climatic Conditions				
WEATHERPROOFING				
WATERPROOFING				
8.1.2.1	101	3	7.1.16	Weatherproofing of fuselage

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
DUST AND SAND PROOFING				
8.1.2.2	101	4	7.1.22	Protection against sand and dust
8.1.2.3	101	4	7.1.23	Prevention of accumulation of sand inside fuselage structure
8.1.2.4	101	4	7.1.24	Operation of hydraulic equipment under sandy conditions
8.1.2.5	101	4	7.1.25	Prevention of sand and dust into plain, ball and roller bearings
PROTECTION AGAINST ICING				
8.1.2.6	101	5	7.1.26	Design of aeroplane to accommodate ice or freezing of accumulated water
8.1.3 Precautions Against Corrosion And Deterioration				
8.1.3.1	409	1	4.3.1	Reference to DEF STAN 00-970 Issue 1
BASIC OPERATIONAL REQUIREMENTS				
8.1.3.2	409	2	4.3.2	Aims of protecting the structure
EXCLUSION OF CONTAMINATING LIQUIDS				
GENERAL				
8.1.3.3	409	3	4.3.3	Sealing of static joints
RAIN AND AIRBORNE SPRAY				
8.1.3.4	409	3	4.3.4	Prevention of water leaking into the structure
OTHER FLUIDS				
8.1.3.5	409	3	4.3.5	Design of aeroplane to minimise corrosion because of leaked fluids
8.1.3.6	409	3	4.3.6	Design in compartments where fluids are likely to be spilt
8.1.3.7	409	3	4.3.7	Corrosion requirements for heat and sound proofing materials
DRAINAGE AND VENTING				
8.1.3.8	409	3	4.3.8	Drainage and venting of all compartments in the structure
ACCESS FOR EXAMINATION				
8.1.3.9	409	4	4.3.9	Access to every part of the structure for visual examination
DESIGNATION OF THE REQUIREMENTS FOR THE PROTECTION OF PARTS AND ASSEMBLIES				
8.1.3.10	409	7	4.3.13	Indication of treatments in item and assembly drawings
TREATMENT OF SYNTHETIC RESIN COMPOSITES				
8.1.3.11	409	21	4.3.99	Treatment of internal surfaces
8.1.3.12	409	21	4.3.100	Treatment of external surfaces
8.1.3.13	409	21	4.3.101	Design to prevent galvanic corrosion
PRECAUTIONS AND TREATMENTS DURING ASSEMBLY				
FIELD OF APPLICATION				
8.1.3.14	409	24	4.3.104	Scope of requirement
WET ASSEMBLY				
8.1.3.15	409	24	4.3.105	Requirement for static joints
8.1.3.16	409	24	4.3.106	Sealants
8.1.3.17	409	24	4.3.107	Jointing compounds
MATERIALS APPROVED FOR WET ASSEMBLY				
8.1.3.18	409	24	4.3.108	Preferred sealant for fuel tanks, cabin skins and pressure capsules
8.1.3.19	409	24	4.3.109	Acceptable jointing compounds
EXCEPTIONS AND SPECIAL CASES				
8.1.3.20	409	24	4.3.110	Spot and seam welds
8.1.3.21	409	24	4.3.111	Adhesive bonded joints
8.1.3.22	409	24	4.3.112	Screwed unions in liquid and gaseous systems
8.1.3.23	409	24	4.3.113	Lubricated joints
8.1.3.24	409	24	4.3.114	Joints with anti-fretting treatments

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
NON-METALLIC SHIMMING AND PACKING MATERIALS				
8.1.3.25	409	24	4.3.115	Material selection and assembly requirements
METAL SHIMS				
8.1.3.26	409	24	4.3.116	Assembly of sacrificial metal shims
TREATMENT AFTER ASSEMBLY: TOUCHING UP				
GENERAL REQUIREMENTS				
8.1.3.27	409	25	4.3.117	Requirements for inspection and treatment before final painting
TOUCH UP OF SURFACE TREATMENTS				
8.1.3.28	409	25	4.3.118	Repair of surface treatments
8.1.3.29	409	25	4.3.119	Treatment of non-corrosion-resisting steels
8.1.3.30	409	25	4.3.120	Treatment of aluminium and its alloys
8.1.3.31	409	25	4.3.121	Treatment of magnesium alloys
SPARE PARTS				
8.1.3.32	409	26	4.3.122	Scope of clauses 4.3.[123-134]
GENERAL REQUIREMENTS				
8.1.3.33	409	26	4.3.123	Protection of spare parts
8.1.3.34	409	26	4.3.124	Protection of primed parts
8.1.3.35	409	26	4.3.125	Temporary protectants and protection for long term and tropical storage
NON-CORROSION-REISTING STEEL PARTS				
8.1.3.36	409	26	4.3.126	Temporary protective coating on plated parts
8.1.3.37	409	26	4.3.127	Temporary protective for aluminium metallised parts
8.1.3.38	409	26	4.3.128	Requirement for primer on phosphated parts
8.1.3.39	409	26	4.3.129	Requirements for lubricated parts
ALUMINIUM AND ALUMINIUM ALLOY PARTS				
8.1.3.40	409	26	4.3.130	Requirements for anodised or chromate filmed parts
8.1.3.41	409	26	4.3.131	Requirement for parts not anodised or chromate filmed
8.1.3.42	409	26	4.3.132	Requirement for parts metallised with aluminium or aluminium-zinc alloy
MAGNESIUM ALOY PARTS				
8.1.3.43	409	26	4.3.133	Requirement for supply in fully protected condition
CRATING AND STOWAGE				
8.1.3.44	409	26	4.3.134	Requirement to consider hazards of transport
8.1.3.45	409	L0	S4/L0	References
8.1.3.46	409	L3	S4/L10	Protection of structure - Avoidance of galvanic corrosion at bimetallic contacts
8.1.4 Protection From The Effects Of Nuclear Explosions, Laser Weapons, Chemical And Biological Warfare Agents				
INTRODUCTION				
8.1.4.1	723	1	9.11.1	Applicability of clauses
8.1.4.2	723	1	9.11.2	Requirements for NBC/laser hardening
8.1.4.3	723	1	9.11.3	Security classification of references
GENERAL				
8.1.4.4	723	2	9.11.4	Operation by personnel in NBC and laser protective clothing
8.1.4.5	723	2	9.11.5	Maintenance, replenishment and rearmament in NBC clothing
CHEMICAL AND BIOLOGICAL ENVIRONMENT REQUIREMENTS				
GENERAL				
8.1.4.6	723	4	9.11.12	Determination of level of chemical hardening

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
DESIGN				
8.1.4.7	723	4	9.11.13	Design objective
8.1.4.8	723	4	9.11.14	Principal design aim
8.1.4.9	723	4	9.11.15	Repeated operation while contaminated
8.1.4.10	723	4	9.11.16	Design for resistance to attack
8.1.4.11	723	4	9.11.17	Design for handling and decontamination
8.1.4.12	723	4	9.11.18	Requirement for Chemical and Biological survivability feasibility study
8.1.4.13	723	4	9.11.19	Design for prevention of ingress of liquid chemical agents
8.1.4.14	723	4	9.11.20	Design criteria for environmental control system
8.1.4.15	723	4	9.11.21	Use of all weather seals to preclude CW or BW contaminants
8.1.4.16	723	4	9.11.22	Suitable filtration
8.1.4.17	723	4	9.11.23	Requirements for materials liable to contamination
CHEMICAL AND BIOLOGICAL TESTING				
8.1.4.18	723	4	9.11.24	Provision of materials proposed for defined uses
8.1.5 Waterproofing				
WATERPROOFING				
WATERPROOFING				
8.1.5.1	1013	1	7.1.17	Ground tests
8.1.5.2	1013	2	7.1.17	Ground tests
8.1.5.3	1013	3	7.1.16	Weatherproofing of fuselage
8.1.5.4	1013	4	7.1.17	Ground tests
8.1.5.5	1013	4	7.1.18	Tests for aeroplanes that has components which may be folded
8.1.5.6	1013	4	7.1.19	Repeat tests on areas that have been rectified
FLIGHT TESTS				
8.1.5.7	1013	5	7.1.20	Requirement to perform flight test
8.1.5.8	1013	5	7.1.21	Repeat flight and ground tests following remedial action
8.2 Specific Structures				
8.2.1 Precautions Against Corrosion and Deterioration				
8.2.1.1	409	22	4.3.102	Effect of materials on radar transparency
8.2.2 Radio And Radar Installations				
STATIC ELECTRICAL CHARGES				
8.2.2.1	708	8	6.1.46	Provision for the dispersal of electrical charges
9. QUALITY CONTROL				
Aim:	To ensure that the structure is of an acceptable quality.			
Compliance:	A quality control plan that is an integral part of the overall plan and recognises the requirements arising from potential failure modes, damage tolerance and flaw growth requirements, loadings, inspectability and local sensitivities to manufacture and assembly.			
9.1 General Requirements				
9.1.1 Processes And Working Of Materials				
9.1.1.1	402	6	4.6.10	Adhesive Bonding

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
9.1.2 Bond Durability				
9.1.2.1				ADF TAR requirement - Adhesive Bonding The wedge test specified in Leaflet 2 para 5.2, eg ASTM D3762, should meet the requirements of RAAF STD ENG C5033 para 15.9.
9.1.2.2	402	L2	S4/L16	Processes and working of materials - Adhesive bonding of structural parts - process and control
10. PRODUCTION SPECIFICATIONS				
Aim:	To ensure the reproducible fabrication of reliable structure.			
Compliance:	Specifications defining materials, material processing and fabrication procedures. The discrepancies permitted by the specifications should be substantiated by analysis supported by test evidence, or tests at the coupon, element or subcomponent level.			
10.1 General Requirements				
10.1.1 General Detail Design				
GRADING OF PARTS AND ASSEMBLIES				
INTRODUCTION				
10.1.1.1	400	2	4.1.4	Appropriate quality control and testing
10.1.1.2	400	2	4.1.5	Grading of standard parts
GRADING REQIUREMENTS				
10.1.1.3	400	2	4.1.6	Grade A selection criteria
10.1.1.4	400	2	4.1.7	Grade B selection criteria
DRAWINGS AND QUALITY CONTROL				
10.1.1.5	400	2	4.1.8	Quality control requirements on drawings
10.1.1.6	400	2	4.1.9	Additional quality control requirements
STANDARD PARTS				
10.1.1.7	400	3	4.1.10	Requirements of other standards
10.1.1.8	400	3	4.1.11	Other series
10.1.1.9	400	3	4.1.12	Issue number of drawing
MATERIALS AND PROCESSES				
10.1.1.10	400	4	4.1.13	Material and manufacture processes for Grade A parts
10.1.1.11	400	4	4.1.14	Specification for unapproved material or processes on Grade A parts
10.1.1.12	400	4	4.1.15	Material specifications for Grade B parts
STRENGTH OF MATERIALS				
10.1.1.13	400	5	4.1.16	Guidance regarding strength of defined materials
LOCKING OF THREADED FASTENERS				
10.1.1.14	400	7	4.1.18	Standard of locking
10.1.1.15	400	7	4.1.19	Grade A applications
10.1.1.16	400	7	4.1.20	Grade B applications
10.1.1.17	400	7	4.1.21	Locking wire
10.1.1.18	400	7	4.1.22	Centre popping
10.1.1.19	400	7	4.1.23	Peening
10.1.1.20	400	7	4.1.24	Locking adhesives
10.1.1.21	400	7	4.1.25	End protrusion
10.1.1.22	400	7	4.1.26	Damage to protective treatment

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
USE OF COLD FORGED STEEL BOLTS				
10.1.1.23	400	9	4.1.28	Specification for cold forged steel bolts
CONTROLLED TIGHTENING OF BOLTS				
OPERATIONAL REQUIREMENTS				
10.1.1.24	400	12	4.1.34	Scope of application
10.1.1.25	400	12	4.1.35	Bolt elongation technique
10.1.1.26	400	12	4.1.36	Access for torque loading tools
SAFETY REQUIREMENTS				
10.1.1.27	400	12	4.1.37	Requirements for drawings
10.1.1.28	400	12	4.1.38	Lubricant compatibility
10.1.1.29	400	12	4.1.39	Effect of hot joints on torque upon re-assembly
10.1.1.30	400	L1	S4/L1	General detail design - Grading of aeroplane parts and assemblies
10.1.1.31	400	L3	S4/L3	General detail design – Controlled tightening of bolts
10.1.1.32	400	L4	S4/L4	General detail design – locking of threaded fasteners
10.1.2 Processes And Working Of Materials				
JOINTING PROCESSES				
10.1.2.1	402	1	4.6.2	Grading of joints made by metallic jointing processes
STRENGTH AFTER PROCESSING				
DETAIL DRAWINGS				
10.1.2.2	402	2	4.6.3	Documentation requirements for process dependant joints
10.1.2.3	402	2	4.6.4	Properties for welded joints
FLAW DETECTION				
10.1.2.4	402	4	4.6.6	Need for flaw detection
ADHESIVE BONDING				
10.1.2.5	402	6	4.6.10	Validation of Grade A components
SEALANTS AND SEALING				
10.1.2.6	402	7	4.6.11	Specification for sealing processes
10.1.2.7	402	7	4.6.12	Ensure appropriate pre-treatment on surfaces to be sealed
10.1.2.8	402	7	4.6.13	Leak resistance
10.1.2.9	402	7	4.6.14	Consideration of concentrated loads
10.1.2.10	402	L0	S4/L0	References
10.1.2.11	402	L2	S4/L16	Processes and working of materials - Adhesive bonding of structural parts – process and control
10.1.2.12	402	L3	S4/L17	Processes and working of materials - Adhesive bonding of structural parts – recommended design practice
10.1.2.13	402	L7	S4/L20	Processes and working of materials - Sealants and sealing
10.1.3 Precautions Against Corrosion And Deterioration				
10.1.3.1	409	7	4.3.13	Designation Of The Requirements For The Protection Of Parts And Assemblies
10.1.4 Quality Control				
10.1.4.1				ADF TAR requirement - Quality Control All quality control procedures shall be included in the production specifications

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
11. INSPECTION AND MAINTENANCE				
Aim:	To ensure the structure can be adequately transported, handled, stored and maintained while in service.			
Compliance:	Maintenance manuals that include appropriate inspection, maintenance and repair procedures.			
11.1 General Requirements				
11.1.1 General Requirements				
RELIABILITY				
11.1.1.1	100	26	1.1.40	Specification of reliability requirements
11.1.2 General Maintenance Requirements				
11.1.2.1	800	1	4.4.1	Reference to DEF STAN 00-970 Issue 1 and JAR 25.611
11.1.2.2	800	1	4.4.2	Design to minimise need for servicing and inspection
DESIGNING FOR MAINTENANCE				
11.1.2.3	800	2	4.4.3	Compliance and guidance regarding design for maintenance
TRANSPORT, HANDLING AND STORAGE				
11.1.2.4	800	3	4.4.8	Guidance regarding origin of Clauses 4.4.[8-24]
ROUTINE SERVICING				
11.1.2.5	800	4	4.4.25	Guidance regarding origin of Clauses 4.4.[25-32]
REPLACEMENT OF COMPONENTS				
11.1.2.6	800	5	4.4.38	Guidance regarding origin of Clauses 4.4.[38-47]
ACCESSIBILITY				
11.1.2.7	800	6	4.4.4	Compliance for practical access to permit inspection
CONDITION INSPECTION EQUIPMENT				
11.1.2.8	800	8	4.4.6	Consideration for the installation of condition monitoring equipment
11.1.3 Transport, Handling And Storage				
TRANSPORT OF COMPONENTS				
11.1.3.1	801	1	4.4.9	Sub-division of aeroplane to facilitate packing and transport
GROUND HANDLING				
11.1.3.2	801	2	4.4.10	Compliance and guidance regarding use of standard equipment and tools
JACKING				
11.1.3.3	801	3	4.4.11	Requirement for three jacking points
11.1.3.4	801	3	4.4.12	Jacking at or near the axles to change deflated tyres
11.1.3.5	801	3	4.4.13	Stability of aeroplane on jacks
11.1.3.6	801	3	4.4.14	Minimum clearance to facilitate tripod jacks
11.1.3.7	801	3	4.4.15	Requirements for jacking pads
11.1.3.8	801	3	4.4.16	Marking of jacking points
SLINGING				
RAF AEROPLANES				
11.1.3.9	801	4	4.4.17	Provision for lifting slings
NAVAL AEROPLANES				
11.1.3.10	801	4	4.4.18	Provision for slinging complete aeroplane
COMPONENTS				
11.1.3.11	801	4	4.4.19	Provision for slinging heavy components
MARKING OF SLINGING POINTS				
11.1.3.12	801	4	4.4.20	Marking of slinging points

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
GROUND TOWING				
11.1.3.13	801	5	4.4.21	Provision for towing and pushing
TOWING POINTS				
11.1.3.14	801	5	4.4.22	Accessibility and marking of towing points
LOAD LIMITATIONS				
11.1.3.15	801	5	4.4.23	Load limiting devices on towing arms
11.1.3.16	801	L0	S6/L0	References
11.1.4 Routine Servicing				
GENERAL				
11.1.4.1	802	1	4.4.26	Compliance and guidance regarding design for servicing
TURN ROUND				
11.1.4.2	802	1	4.4.27	Servicing without damage to aeroplane finish
AUTOMATIC BREAKAWAY CONNECTION				
11.1.4.3	802	1	4.4. 28	Compliance regarding automatic disconnection from ground connections
INSPECTION				
11.1.4.4	802	2	4.4.29	Accessibility of parts that require frequent inspection or replacement
11.1.4.5	802	2	4.4.30	Accessibility of parts in Naval aeroplanes
GASEOUS SYSTEMS				
11.1.4.6	802	3	4.4.32	Provision for charging gaseous systems in-situ
11.1.4.7	802	L0	S6/L0	References
11.1.5 Replacement Of Components				
DISMANTLING AND ERECTION				
11.1.5.1	804	1	4.4.39	Compliance and guidance regarding dismantling and erection
11.1.6 Interchangeability				
INTERCHANGEABILITY				
11.1.6.1	805	1	4.4.48	Guidance regarding origin of clauses 4.4.[48-63]
BASIC REQUIREMENT				
11.1.6.2	805	2	4.4.49	Replacement of items without degrading their functional capability
11.1.6.3	805	3	4.4.49	Replacement of items without degrading their functional capability
PHYSICAL CHARACTERISTICS AND FUNCTIONAL CHARACTERISTICS				
11.1.6.4	805	3	4.4.50	Definition of physical and functional characteristics
LIMITS				
11.1.6.5	805	4	4.4.51	Statement of limits on dimensions that affect assembly and function
JIGS, TEMPLATES AND GAUGES				
11.1.6.6	805	5	4.4.52	Provision of jigs, templates and gauges necessary for interchangeability
DIMENSIONING OF DRAWINGS				
11.1.6.7	805	6	4.4.53	Coordinate system and datum's for drawings of parts
DATA SHEETS				
11.1.6.8	805	7	4.4.54	Inclusion of interchangeability data sheets in Master Record Index
11.1.6.9	805	7	4.4.55	Requirements of 4.4.54 for sub-divided components
ATTACHMENT OF MAIN COMPONENTS				
11.1.6.10	805	8	4.4.56	Compliance regarding the use of removable parts in the fitment of main components
HINGES				
DATUM				
11.1.6.11	805	9	4.4.57	Requirement for the provision of datum hinges

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
MINIMUM CLEARANCES				
11.1.6.12	805	9	4.4.58	Clearance between male and female hinges
PIANO HINGES				
11.1.6.13	805	10	4.4.59	Attachment of piano hinges
COWLINGS AND PANELS				
11.1.6.14	805	11	4.4.60	Compliance regarding method to obtain interchangeability of cowlings and panels etc.
AERODYNAMIC CHARACTERISTICS				
11.1.6.15	805	12	4.4.61	Guidance regarding contour variation on aerodynamic components
CRITICAL POSITIONING				
11.1.6.16	805	12	4.4.62	Provision of tolerances for parts where relative position is critical
AILERONS				
11.1.6.17	805	12	4.4.63	Requirement to avoid use of adjustable hinges to satisfy 4.4.[61&62]
11.1.6.18	805	L0	S6/L0	References
11.1.7 Marking And Notices				
11.1.7.1	806	1	7.3.2	Reference to standard for external colouring and markings
RIGGING AND CG DATUM MARKS				
11.1.7.2	806	3	7.3.20	Provision of means for indicating rigging position and centre of gravity
DATUM POINTS				
11.1.7.3	806	3	7.3.21	Provision of cg datum point with clear access to ground
11.1.7.4	806	3	7.3.22	Marking to be used for cg datum point
11.1.7.5	806	3	7.3.23	Provision of datum points for rigging purposes
LONGITUDINAL AND LATERAL RIGGING POSITIONS				
11.1.7.6	806	3	7.3.24	Specification of longitudinal and lateral rigging positions
CG POSITION				
11.1.7.7	806	3	7.3.25	Requirements of reference axes for cg position
11.1.7.8	806	3	7.3.26	Sign convention for cg coordinates relative to reference axes
SERVICING POINTS				
GENERAL				
11.1.7.9	806	4	7.3.27	Reference to standard defining markings for service points
FUEL				
11.1.7.10	806	4	7.3.28	Notices for aeroplanes requiring pressure refuelling or defuelling
STRONG POINTS				
11.1.7.11	806	10	7.3.38	Reference to standard for marking of strong points for ground handling
WALKWAYS				
11.1.7.12	806	11	7.3.39	Reference to standard for marking of boundaries of walkways
11.1.7.13	806	L0	S7/L0	References
11.2 Specific Structures				
11.2.1 Radio And Radar Installations				
SERVICING				
11.2.1.1	708	10	6.1.48	Servicing requirements for radio and radar units

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
12. SUBSTANTIATION OF REPAIR				
Aim: To ensure that repairs will restore the structure to an airworthy condition.				
Compliance: Analysis and/or test to demonstrate that methods and techniques of repair restore the structure to an airworthy condition.				
12.1 General Requirements				
12.1.1 Repairs				
GENERAL				
12.1.1.1	803	1	4.4.34	Compliance regarding design for ease of repair
STRENGTH				
12.1.1.2	803	2	4.4.35	Repairs must comply with all relevant design requirements for aeroplane
MATERIAL				
12.1.1.3	803	3	4.4.36	Use of standard materials and methods of repair
COMPOSITE MATERIALS				
12.1.1.4	803	4	4.4.37	Requirement for flush repairs and repairs on panels and cowlings
12.1.2 Reduction Of Vulnerability To Battle Damage				
VULNERABILITY ANALYSIS				
12.1.2.1	112	4	9.9.7	Method to determine vulnerability standards
BATTLE DAMAGE REPAIR				
12.1.2.2	112	5	9.9.8	Consideration and provision for battle damage repair
12.1.2.3	112	L1	S9/L22	Reduction of vulnerability to battle damage - General requirements
12.1.3 Airframe Design To Resist Birdstrike Damage				
12.1.3.1	209	2	4.9.3	Airframe Design To Resist Birdstrike Damage
12.1.4 Comply With RAAF STD ENG C5033				
12.1.4.1				ADF TAR requirement - compliance with RAAF STD ENG C5033 Comply with RAAF STD ENG C5033
13. NOISE AND VIBRATION				
Aim: To ensure that the structure can tolerate the effects of noise and vibration for the life of the aircraft.				
Compliance: Test or analysis.				
13.1 General Requirements				
NOISE AND VIBRATION				
13.1.1.1	100	5	1.1.6	Design considerations for noise and vibration
13.1.2 Requirements For Structural And Equipment Exposure To Noise And Vibration				
13.1.2.1	501	1	2.23.1	Aim of noise and vibration requirements
13.1.2.2	501	1	2.23.2	Reference to leaflets describing sources of noise and vibration
REQUIREMENTS OF THE RESPONSIBLE AGENCIES				
13.1.2.3	501	2	2.23.3	Agencies responsible for provision of noise and vibration information
NOISE AND VIBRATION REQUIREMENTS				
REQUIREMENTS FOR AIRFRAME				
13.1.2.4	501	3	2.23.4	Consideration of noise and vibration on aeroplane design

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
REQUIREMENTS FOR EQUIPMENT				
13.1.2.5	501	3	2.23.5	Operation of equipment in noise and vibration environment
13.1.2.6	501	3	2.23.6	Consideration of noise and vibration on equipment design
REQUIREMENTS FOR HUMAN EXPOSURE				
13.1.2.7	501	3	2.23.7	Reference to Clause defining environment for crew and passengers
FLIGHT VIBRATION SURVEY				
13.1.2.8	501	4	2.23.8	Requirement for flight vibration study
13.1.2.9	501	L2	S2/L62	Requirements for structural and equipment exposure to noise and vibration - Sources of noise and vibration
13.1.2.10	501	L3	S2/L63	Requirements for structural and equipment exposure to noise and vibration - Data analysis and assessment
13.1.2.11	501	L4	S2/L64	Requirements for structural and equipment exposure to noise and vibration - The vibration effects of gunfire
13.1.2.12	501	L5	S2/L65	Requirements for structural and equipment exposure to noise and vibration - The gunfire blast pressure field
13.1.2.13	501	L6	S2/L66	Requirements for structural and equipment exposure to noise and vibration - Propeller aeroplanes
13.2 Specific Structures				
13.2.1 Radio And Radar Installations				
AERIAL DESIGN				
13.2.1.1	708	2	6.1.18	Electrical performance considerations
13.2.1.2	708	2	6.1.19	Mechanical performance considerations
TESTING				
13.2.1.3	708	9	6.1.47	Conduct of flight and ground testing
13.2.1.4	708	L0	S6/L0	References
13.3 Flight Testing				
13.3.1 General Flight Test Requirements - Systems And Structures				
13.3.1.1	1000	1	1.2.1	Scope
13.3.1.2	1000	2	Deleted	
APPLICABILITY				
13.3.1.3	1000	3	1.2.2	Applicability of tests
13.3.1.4	1000	3	1.2.3	Standard of systems
LOADING				
13.3.1.5	1000	5	1.2.7	Loading and centre of gravity requirements for tests
GENERAL TEST CONDITIONS				
13.3.1.6	1000	6	1.2.8	Location of specifications for each test clause
TESTS				
13.3.1.7	1000	7	1.2.9	Responsibility for conducting flight tests
13.3.1.8	1000	7	1.2.10	Specification of limitations prior to flight testing
13.3.2 Flutter And Vibration				
13.3.2.1	1016	1	4.8.1	Scope
FLUTTER AND VIBRATION				
13.3.2.2	1016	1	4.8.10	Purpose of flight flutter tests and flight vibration study

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
FLIGHT FLUTTER TESTING				
13.3.2.3	1016	2	4.8.11	Sequence of flight testing
FLIGHT VIBRATION STUDY				
13.3.2.4	1016	2	4.8.12	Envelope of flight vibration study
13.3.2.5	1016	L1	S4/L32	Flutter and vibration - Fight vibration survey
14. ELECTROMAGNETIC EFFECTS				
Aim:	For the structure to provide adequate shielding from electromagnetic radiation and to possess and acceptable radar cross-section.			
Compliance:	Analysis supported by test.			
14.1 General Requirements				
14.1.1 Bonding And Screening				
14.1.1.1	709	1	4.27.1	Scope of clauses and purpose of bonding
SCREENING AND INTERFERENCE SUPPRESSION				
CIRCUITS				
14.1.1.2	709	2	4.27.2	Enclosure of circuits liable to induce RF disturbances
RADIO INTERFERENCE SUPPRESSORS				
14.1.1.3	709	2	4.27.3	Incorporation of radio interference suppressor components
SUPPRESSION OF IGNITION INTERFERENCE				
14.1.1.4	709	2	4.27.4	Timing for suppression of ignition interference
14.1.1.5	709	2	4.27.5	Fitting of suppressors to L.T. booster coils and associated screening
14.1.1.6	709	2	4.27.6	Fitting of spark gap in H.T. booster coils and associated screening
BONDING				
14.1.1.7	709	3	4.27.7	Bonding requirements for metallic parts of structure and skin
14.1.1.8	709	3	4.27.8	Consideration of bonding for non-metallic parts
14.1.1.9	709	3	4.27.9	Bonding of metallic control and distribution panels
14.1.1.10	709	3	4.27.10	Bonding of the engine
CLASS A BONDING (ANTENNA INSTALLATION)				
14.1.1.11	709	3	4.27.11	General requirement for bonding
14.1.1.12	709	3	4.27.12	Bonding of hatches in vicinity of antenna
14.1.1.13	709	3	4.27.13	Circumferential RF continuity
CLASS C BONDING (CURRENT RETURN PATH)				
14.1.1.14	709	3	4.27.14	Adequacy of bond to carry maximum fault current
14.1.1.15	709	3	4.27.15	Bonding in areas where hazardous conditions exist
CLASS H BONDING (SHOCK HAZARD)				
14.1.1.16	709	3	4.27.16	Exposure of paths containing high voltage
CLASS R BONDING (RF POTENTIAL)				
14.1.1.17	709	3	4.27.17	Bonding of equipment that emits electromagnetic energy
14.1.1.18	709	3	4.27.18	Inherent RF bonding within aeroplane design
14.1.1.19	709	3	4.27.19	Bonding of metallic equipment mountings
14.1.1.20	709	3	4.27.20	RF bonding of cable screens and connector shells
CLASS S BONDING (STATIC CHARGE)				
14.1.1.21	709	3	4.27.21	Mechanically secure connections to aeroplane structure
14.1.1.22	709	3	4.27.22	Bonding of metal parts carrying fluids
14.1.1.23	709	L1	4.27.2	Guidance regarding sources of radio interference and screening continuity

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14.1.2 AAP 7001.054 Section 2, Chapter 2, Paras 1 to 23				
14.1.2.1				AAP 7001.054 Section 2, Chapter 2, Paras 1 to 23
14.1.3 Signature Management				
14.1.3.1				ADF requirement – manage aircraft signature Assess and manage signature (visual, electro-optic, radar) in consultation with Project Office
14.2 Flight Testing				
14.2.1 Electromagnetic Compatibility Of Safety Critical Systems				
14.2.1.1	1011	1	6.10.1	Reference to DEF STAN 00-970 Issue 1 and JAR 25.1431
DESIGN GUIDANCE				
14.2.1.2	1011	2	6.10.2	Guidance regarding documentation requirements
14.2.1.3	1011	3	6.10.1	Scope
EQUIPMENT				
14.2.1.4	1011	4	6.10.3	Equipment required for tests
GENERAL TEST CONDITIONS AND REQUIREMENTS				
14.2.1.5	1011	5	6.10.4	Condition of all electrical/electronic systems during testing
TEST DETAILS				
14.2.1.6	1011	6	6.10.5	Requirements of tests
14.2.1.7	1011	6	6.10.6	Monitoring of induced interference
14.2.1.8	1011	6	6.10.7	Calculation of margins-of-safety
15. IDENTIFICATION OF PARTS				
Aim: To ensure that all parts may be identified. Compliance: Engineering drawings that comply with the requirements.				
15.1 General Requirements				
15.1.1 Operational Colouring And Marking				
15.1.1.1	103	1	7.3.1	Origin of DEF STAN 00-970 Issue 2, Clauses 7.3.[2-39]
15.1.1.2	103	1	7.3.2	Reference to standard for external colouring and markings
AIRFRAME NOTICES				
15.1.1.3	103	6	7.3.14	Types of airframe notices permitted
MAINTENANCE AREAS				
15.1.1.4	103	8	7.3.19	White gloss finish for areas where maintenance occurs
15.1.2 Marking Of Aeroplane Parts				
15.1.2.1	404	1	4.2.1	Origin of clauses in Section 4.2 of DEF STAN 00/970 Issue 2
GENERAL				
15.1.2.2	404	1	4.2.3	Responsibility for selection of type of marking and method of application
15.1.2.3	404	2	4.2.2	Definitions
15.1.2.4	404	3	4.2.4	Effect of markings on strength or life
15.1.2.5	404	3	4.2.5	Effect of marking method on corrosion
15.1.2.6	404	3	4.2.6	Inclusion of marking details on part drawings
15.1.2.7	404	3	4.2.7	Minimal use of markings
15.1.2.8	404	3	4.2.8	Marking for ease of identification when assembled
15.1.2.9	404	3	4.2.9	Use of markings that can be mis-interpreted

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
MARKINGS				
PARTS				
15.1.2.10	404	4	4.2.10	Requirements for the marking of parts
15.1.2.11	404	4	4.2.11	Marking of identical and "handed: parts
15.1.2.12	404	4	4.2.12	Raised disc on head of bolts having significantly different features
15.1.2.13	404	4	4.2.13	Parts that are excluded from all forms of marking
ASSEMBLIES				
15.1.2.14	404	4	4.2.14	Markings for defined elements of assembled parts
15.1.2.15	404	4	4.2.15	Marking of defined fabricated parts
COMPONENTS				
15.1.2.16	404	4	4.2.16	Markings for components or complete units for service storage
AIRFRAME COMPONENTS				
15.1.2.17	404	4	4.2.17	Serial Number Plate and Modification Record for defined components
OIL TANKS				
15.1.2.18	404	4	4.2.18	Markings to be included on oil tanks
FUEL TANKS				
15.1.2.19	404	4	4.2.19	Reference to specification for markings on fuel tanks
REPAIRABLE PARTS				
15.1.2.20	404	4	4.2.20	Identification and marking of items requiring regular repair
RECONDITIONED PARTS				
15.1.2.21	404	4	4.2.21	New markings to be put on reconditioned parts
LOCATION OF IDENTIFICATION MARKINGS				
15.1.2.22	404	7	4.2.29	List of positions in which markings shall not be placed
METHODS OF IDENTIFICATION MARKING				
PHYSICAL IDENTIFICATION METHODS				
15.1.2.23	404	8	4.2.30	Locations on which physical markings shall not be used
15.1.2.24	404	8	4.2.31	Minimisation of stress concentrations
MARKING INK				
15.1.2.25	404	8	4.2.32	Compatibility of marking inks, paints and lacquers
LABELS				
15.1.2.26	404	8	4.2.33	Compatibility of transparent labels
15.1.2.27	404	8	4.2.34	Location of specifications for method to attach metal labels
15.1.2.28	404	8	4.2.35	Marking techniques that cannot be used in presence of powerful oxidants
ELECTROCHEMICAL MARKING				
15.1.2.29	404	8	4.2.36	Parts on which electrochemical marking shall not be used
15.1.2.30	404	L1	S4/L5	Marking of aeroplane parts - Methods for the identification marking of aeroplane parts

16. SPECIFIC ADF REQUIREMENTS

Aim: To ensure that the specific requirements of the ADF are addressed.

Compliance: Analysis, test or experience with similar structure as appropriate for the requirement.

16.1 General Requirements

16.1.1 Reference to Original Certification Basis

16.1.1.1		If the composite parts are replacing existing structure, then the proposed certification basis must address all issues that were included in the original certification of the part being replaced.

Item	Def Stan 00-970 /1 (AL14) Chapt	Para	(Part 1) /2 Clause	Description
16.1.2 Additional Materials				
16.1.2.1				The applicable standards for additional materials, i.e. metals, plastics, sealants, rubbers, wood, transparencies, etc. must be considered.
16.1.3 Aluminium				
16.1.3.1				Aluminium parts should be phosphoric acid anodised to BAC 5555 and primed.
16.2 Specific Structures				
16.2.1 Procedure for Cold Proof Load Test (CPLT)				
16.2.1.1				The procedure that is to be followed when an F-111 aircraft, containing the composite structure, is subjected to a CPLT must be reported.
16.2.2 Metal Honeycomb				
16.2.2.1				All metal honeycomb core is to be of the type which is PA anodised and primed.

Table 3: Summary of the item headings from Table 2.

1. Material and Fabrication Development	1.1 General Requirements	1.1.1 General Requirements
		1.1.2 Operation In Various Climatic Regions
		1.1.3 General Detail Design
		1.1.4 Processes And Working Of Materials
		1.1.5 Precautions Against Corrosion And Deterioration
		1.1.6 Ice Protection
		1.1.7 Peel Ply
	1.2 Specific Structures	1.2.1 Precautions Against Corrosion And Deterioration
		1.2.2 Attachment To Sandwich Structures
2. Proof of Structure - Static	2.1 General Requirements	2.1.1 General Requirements
		2.1.2 Static Strength And Deformation
		2.1.3 General Detail Design
		2.1.4 Protection From The Effects Of Nuclear Explosions, Laser Weapons, Chemical And Biological Warfare Agents
	2.2 Design Cases	2.2.1 Symmetric Manoeuvres
		2.2.2 Asymmetric Manoeuvres
		2.2.3 Gust Loads
		2.2.4 Spinning And Spin Recovery
	2.3 Specific Structures	2.3.1 High Lift Devices And Airbrakes
		2.3.2 Active Control Systems
		2.3.3 Radomes
		2.3.4 Radio And Radar Installations
		2.3.5 Armament Installations
		2.3.6 Pressure Cabins
	2.4 Flight Testing	2.4.1 General Flight Test Requirements - Systems And Structures
		2.4.2 Structures
3. Proof of Structure - Damage/ Fatigue Tolerance	3.1 General Requirements	3.1.1 Fatigue Damage Tolerance
		3.1.2 Processes And Working Of Materials
	3.2 Specific Structures	3.2.1 Radomes
		3.2.2 Pressure Cabins
	3.3 Flight Testing	3.3.1 General Flight Test Requirements - Systems And Structures
		3.3.2 Structures
4. Proof of Structure - Flutter	4.1 General Requirements	4.1.1 Aero-Elasticity
		4.1.2 Active Control Systems
	4.2 Specific Structures	4.2.1 Radio And Radar Installations
	4.3 Flight Testing	4.3.1 General Flight Test Requirements - Systems And Structures
		4.3.2 Flutter And Vibration

Table 3: ...continued from previous page

Additional Considerations		
5. Impact Dynamics	5.1 General Requirements	5.1.1 Reduction Of Vulnerability To Battle Damage
		5.1.2 Protection of Aircrews Against Conventional Weapons
		5.1.3 Airframe Design To Resist Birdstrike Damage
		5.1.4 Crash Landing, Ditching and Precautionary Alighting on Water
		5.1.5 General Detail Design
		5.1.6 Ice Protection
		5.1.7 Protection From The Effects Of Nuclear Explosions, Laser Weapons, Chemical And Biological Warfare Agents
	5.2 Specific Structures	5.2.1 Radomes
		5.2.2 Radio And Radar Installations
6. Flammability	6.1 General Requirements	6.1.1 Fire Precautions
		6.1.2 Reduction Of Vulnerability To Battle Damage
		6.1.3 Crash Landing, Ditching and Precautionary Alighting on Water
7. Lightning Protection	7.1 General Requirements	7.1.1 Bonding And Screening
		7.1.2 Lightning Strike Protection
	7.2 Specific Structures	7.2.1 Radomes
		7.2.2 Radio And Radar Installations
8. Protection of Structure	8.1 General Requirements	8.1.1 General Requirements
		8.1.2 Operation In Various Climatic Conditions
		8.1.3 Precautions Against Corrosion And Deterioration
		8.1.4 Protection From The Effects Of Nuclear Explosions, Laser Weapons, Chemical And Biological Warfare Agents
		8.1.5 Waterproofing
	8.2 Specific Structures	8.2.1 Precautions Against Corrosion and Deterioration
		8.2.2 Radio And Radar Installations
9. Quality Control	9.1 General Requirements	9.1.1 Processes And Working Of Materials
		9.1.2 Bond Durability
10. Production Specifications	10.1 General Requirements	10.1.1 General Detail Design
		10.1.2 Processes And Working Of Materials
		10.1.3 Precautions Against Corrosion And Deterioration
		10.1.4 Quality Control
11. Inspection and Maintenance	11.1 General Requirements	11.1.1 General Requirements
		11.1.2 General Maintenance Requirements
		11.1.3 Transport, Handling And Storage
		11.1.4 Routine Servicing
		11.1.5 Replacement Of Components
		11.1.6 Interchangeability
		11.1.7 Marking And Notices
	11.2 Specific Structures	11.2.1 Radio And Radar Installations

Table 3:...continued from previous page

12. Substantiation of Repair	12.1 General Requirements	12.1.1 Repairs
		12.1.2 Reduction Of Vulnerability To Battle Damage
		12.1.3 Airframe Design To Resist Birdstrike Damage
		12.1.4 Comply With RAAF STD ENG C5033
13. Noise and Vibration	13.1 General Requirements	13.1.2 Requirements For Structural And Equipment Exposure To Noise And Vibration
	13.2 Specific Structures	13.2.1 Radio And Radar Installations
	13.3 Flight Testing	13.3.1 General Flight Test Requirements - Systems And Structures
		13.3.2 Flutter And Vibration
14. Electro-magnetic Effects	14.1 General Requirements	14.1.1 Bonding And Screening
		14.1.2 AAP 7001.054 Section 2, Chapter 2, Paras 1 to 23
		14.1.3 Signature Management
	14.2 Flight Testing	14.2.1 Electromagnetic Compatibility Of Safety Critical Systems
15. Identification of Parts	15.1 General Requirements	15.1.1 Operational Colouring And Marking
		15.1.2 Marking Of Aeroplane Parts
16. Specific ADF Requirements	16.1 General Requirements	16.1.1 Reference To Original Certification Basis
		16.1.2 Additional Materials
		16.1.3 Aluminium
	16.2 Specific Structures	16.2.1 Procedure For Cold Proof Load Test (CPLT)
		16.2.2 Metal Honeycomb

5. Application

Section 4 is not intended to represent the certification basis for a real or hypothetical composite component or aircraft. Rather it indicates all the possible airworthiness requirements derived from DEF STAN 00-970. The certification basis for any particular application will be a subset of these requirements and will need to be developed on a case-by-case basis. For example DSTO and the Cooperative Research Centre for Advanced Composite Structures (CRC-ACS) are developing the technology to replace troublesome metallic aircraft structure (such as bonded honeycomb panels that are prone to corrosion and impact damage) with more cost-effective composite structure [7]. This technology is being demonstrated by the development of a replacement for a F-111 fuselage panel. The CBD for this panel will be derived from Section 4 [8].

6. Discussion

A brief examination was made of the 1999 versions of the MIL-A-88XX series of structural specifications [9, 10, 11, 12, 13, 14, 15, 16, 17]. These are the specifications against which the F-111 was designed to meet [18]. The 1999 version of these standards

were reviewed because the (i) versions current at the time of design of the F-111, typically 18 May 1960, were not available, and (ii) more recent revisions of the specifications reflect the current approach and improvements in knowledge made since the versions current in 1960. They are considered to represent the typical specifications for military aircraft designed in the USA.

The examination revealed no significant differences in the issues covered by the MIL-A-88XX series and DEF STAN 00-970. There are certainly differences in some of the requirements, for example DEF STAN 00-970 states that full-scale fatigue testing of aircraft is normally continued for five times the specified life while MIL-A-8867C(AS) states four lifetimes, however there are no additional issues that were covered in MIL-A-88XX that were not covered in DEF STAN 00-970. Therefore it may be concluded that the requirements stated in Section 4 of this report will identify all of the issues likely to have been required in military aircraft designed to US military specifications.

A reasonable effort was made to identify all relevant airworthiness issues for composite structure and include these in Section 4. It is possible that a detailed inspection of the MIL-A-88XX and other airworthiness requirements may identify issues that have not been included, however a substantial level of effort would be required to perform such an examination. Such effort is outside the scope of this report.

7. Acknowledgments

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8. References

1 Royal Australian Air Force, "Airworthiness Design Requirements Manual", AAP 7001.054(AM1), File Reference: SCI/4560/7001/054, 28 September 2001.

2 U. K. Ministry of Defence, "Design and Airworthiness Requirements for Service Aircraft, Volume 1 - Aeroplanes", DEF STAN 00-970, Issue 1, Amendment Number 14, Directorate of Standardization, U.K., 12 December 1983.

3 Federal Aviation Administration, "Composite aircraft structure", Advisory Circular No: 20-107A, U.S. Department of Transportation, April 1984, 11 pp.

4 Federal Aviation Administration, "Federal Aviation Regulations, Part 25, Airworthiness Standards: Transport Category Airplanes", U.S. Department of Transportation, October 1994.

5 Joint Aviation Authorities, "Joint Aviation Requirements, JAR-25, Large Aeroplanes".

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16 United States of America, Department of Defense, "Airplane strength and rigidity, Nuclear weapons effects", MIL-A-8869B(AS), 20 May 1987, 5 pp.
17 United States of America, Department of Defense, "Airplane strength and rigidity, Vibration, flutter, and divergence", MIL-A-8870C(AS), 25 March 1993, 51 pp.
18 Royal Australian Air Force, "F-111 Aircraft Structural Integrity Management Plan", F/RF-111C/G ASIMP Issue 2, 19 December, 2001.

Appendix A: Selected Summary of DEF STAN 00-970/1 (AL14)

Table A1 summarises those Chapters, Leaflets and paragraphs of DEF STAN 00-970/1 (AL14) that were identified as relevant to the airworthiness of composite structure. In the summarised sections, the paragraph headings are transcribed exactly and are shown in italics. The contents of the summaries have been paraphrased and shortened from the requirements. Table A1 also contains an exact transcription of every Part and Chapter title in DEF STAN 00-970/1 (AL14).

It is intended that the faithful reproduction of titles and paragraph headings will provide the reader with an accurate reflection of the scope of DEF STAN 00-970/1 (AL14). Similarly, the summarised requirements and guidance provide a reasonably comprehensive representation of the contents of those sections. However these summaries must not be considered a reference source from which to prepare or assess a certification basis. The complete DEF STAN 00-970/1 (AL14) must be used for this purpose.

Table A1: Summary of DEF STAN 00-970/1 (AL14).

PART 1 GENERAL AND OPERATIONAL REQUIREMENTS
Chapter 100 General Requirements *Para 2. Standard Items (see also Chapter 400):* Must meet requirements of DEF STAN 00-00 (Part 3) Section 1, Chapters 1 &2. Unless duly authorised, no other items will be used to perform a function if it can be performed by standard item. *Para 3. Installation information for items of equipment:* All equipment to be installed in accordance with relevant document. *Para 4. Strength:* Strength clauses have been introduced into chapters whenever applicable. These vary in form, but in all cases the applicability of the general strength requirements of the aeroplane to the installation shall be considered. *Para 5. Noise and vibration:* The design shall consider the undue effects of noise and vibration on the aeroplane's structure, its instruments and avionics equipment and the operational efficiency of the crew. *Para 6. Tests:* Unless otherwise stated tests shall be considered as applying to prototypes and shall be conducted on all prototypes. Where components are subject to separate specifications, the tests required by those specifications shall be carried out before installation. Where necessary, such components shall also be included in subsequent tests. *Para 7. Prevention of incorrect assembly of systems:* It shall be mechanical impossible to incorrectly assemble systems which, if incorrectly assembled would cause accidents or major damage. Every effort shall be made to prevent incorrect assembly in other systems. Clear markings are required as a minimum. *Para 8. Conditions of operation (see also Chapter 101, paras 1 and 2):* All installations and systems shall function correctly under all conditions, on the ground, in flight and at altitude, for which they are required to operate. *Para 17. Loose article hazards - control systems (see also Chapter 206, para 3.3.3 and Leaflet 206/6, para 2.2):* The flight and propulsion system shall be designed to prevent loose articles entering or jamming the system. Consider preventing the generation of loose articles, access for visual detection and incorporation of guards. *Para 18. Prevention of accidental damage:* Aeroplane shall be designed, and guards provided, to minimise risk of accidental damage. Guards to be arranged so loose articles cannot enter system, and shall be readily detachable. *Para 26. Reliability:* Reliability requirements will be stated in Aeroplane specification (DEF STANs 00-40 and 00-41 also refer).

Chapter 101 Operation in Various Climatic Conditions *Para 1. Temperature limits:* Aeroplane shall be suitable for operating at all heights throughout the world. Appropriate allowance to be made for kinetic heating, shielding and thermal lag. Aeroplane, instruments and equipment shall be able to operate for take-off in range -30 to +70°C, and not be damaged by acquisition of -40 to +90°C. *Para 2. Humidity limits:* Aeroplane, instruments and equipment shall function satisfactorily within design humidity temperature envelope. For altitude below 10000 ft use plot, for altitudes above 10000 ft use 100 % RH associated with the appropriate maximum temperature. Design and test requirements given in BS3G100. *Para 3. Weatherproofing:* Essential that fuselage prevents the entry of rain in flight or on the ground. *Para 4. Dust and sand proofing:* Provision shall be made to exclude dust and sand from all working parts. *Para 5. Protection against icing:* Aeroplane shall be designed so that a build-up of ice, or the freezing of collected water does not impede correct operation. Where necessary, aerodynamic surfaces shall be protected by a system to prevent or remove any ice accretion.
Leaflet 101/0 Reference Page Gives titles and numbers of publications regarding environmental effects on aeroplanes.
Leaflet 101/2 Standard Atmospheric Conditions *Para 1. Introduction:* Leaflet defines standard atmospheres to be used for design purposes and performance estimates. Note that these do not define realistic atmospheres, which could occur at any time. *Para 2. International (I.C.A.O) standard atmosphere:* Table of temperature, relative pressure and relative density of ICAO Standard Atmosphere. *Para 3. Mean tropical standard atmosphere:* Table of temperature, relative pressure and relative density of ICAO Mean Tropical Standard Atmosphere.
Leaflet 101/3 Temperature Limits for Design Purposes *Para 1. Introduction:* Leaflet gives some information on the derivation of temperature requirements of Chapter 101. *Para 2. Outside air temperatures:* Maximum sea level temperature of +45°C is the maximum likely to be required, although over 60°C has been recorded in the Sahara. Minimum sea level temperature should be -40°C, but Air and Navy have granted concession to -30°C. These limits are fully required for some service locations. *Para 3. Temperatures acquired by aeroplanes and their equipment:* On ground have found upper surface of metal wings in Australian tropics reaching 87°C. Thus require 90°C resistance, and operation at 70°C. In flight must account for kinetic heating. A relation is given to calculate this. Solar radiation effects appear to be negligible.
Leaflet 101/4 Humidity Conditions *Para 1. Definitions:* Definitions given for absolute humidity, specific humidity, humidity mixing ratio, saturation humidity, percentage saturation and relative humidity. *Para 2. Humidity mixing ratio:* Gives relation to calculate humidity mixing ratio. *Para 3. Percentage saturation:* Gives relation to calculate percentage saturation. *Para 4. Humidity limits:* Derived from sea level vapour pressure values at Aden (warm humid) and Habbaniya (hot dry) stations. Values not generally exceeded more than once per month. *Para 5. Maximum humidity limits for design purposes:* Maximum humidity limits should be used for design purposes. In certain specific cases, with the prior approval of the APD, the mean humidity limits may be used.
Chapter 102 Emergency Escape Not relevant to composite structure.
Chapter 103 Operational Colouring and Markings *Para 1. Introduction:* External colouring according to AP119A-0601-0 Chapt. 3. This Chapter defines interior operational colouring and marking. Colours in accordance with BS381C. Chapt 801 gives precaution against corrosion. *Para 6. Airframe notices:* Restricted to instructions definitely required in the air, notices on panels to ease maintenance and emergency notices. Emergency notices to be confined to operations required in real emergencies. *Para 8. Maintenance areas:* White glossy finish to be provided in all areas requiring maintenance. Agreement with APD needed on areas to be so painted. This finish shall not prejudice camouflage or other protective finish.
Chapter 104 View and Clear Vision Not relevant to composite structure.
Chapter 105 Crew Stations - General Requirements Not relevant to composite structure.
Chapter 106 Pilot's Station - Layout Not relevant to composite structure.
Chapter 107 Pilot's Cockpit - Controls and Instruments Not relevant to composite structure.
Chapter 108 Requirements for Human Exposure to Noise and Vibration in Cockpits and Cabins Not relevant to composite structure.
Chapter 109 Normal Entrance and Exit Not relevant to composite structure.
Chapter 110 Navigation and Anti-Collision Lights Not relevant to composite structure.

Chapter 111 Restraint and Parachute Harness for Aircrew Not relevant to composite structure.
Chapter 112 Reduction of Vulnerability to Battle Damage *Para 1. Introduction:* Chapter contains design aims and requirements to enhance the survivability of aeroplane and crew by reducing their vulnerability to battle damage. *Para 2. Definitions:* Definitions of survivability, vulnerability, susceptibility, threats, sortie, mission, battle damage repair, probability of occurrence. *Para 3. Design:* Maximise probability that no single defined threat will degrade flying qualities below level 3 (Def Stan 00-970, Vol. 1, Pt 6). Consideration to be given to; vulnerability of all systems, reducing vulnerability of critical systems, isolating and suppressing fire, separation of ignition sources and flammable fluids, NBC repairability and residual strength effects when assessing materials, hits on pressurised vessels. *Para 4. Vulnerability analysis:* Agree on how vulnerability will be assessed with Aeroplane Project Director (APD). Do a casualty reduction analysis. *Para 5. Battle damage repair:* Consider and provide for BDR of structure, flight critical systems and mission critical systems.
Leaflet 112/1 General Requirements *Para 1. General:* Survivability depends on an aeroplane's susceptibility and vulnerability. *Para 2. Design aims:* Strategy to reduce vulnerability based on damage tolerant components, layout, redundancy, damage control equipment, shielding, reduction of airframe vulnerability. *Para 3. Protection measures:* Lists protection measures for fuel systems, power systems and signalling for flying controls, engines, crew, and structure. *Para 4. Battle damage repair:* Designer should consider how to get aircraft airworthy after battle damage and information for repair manuals. Incorporate features to assist in BDR. *Para 5. UK kill categories:* Defines F(t), C(t) and E(t). *Para 6. US kill categories:* Defines catastrophic, mission abort, mission available and repair time kills.
Chapter 113 Microlight Aeroplanes Not relevant to composite structure.
Chapter 114 Protection of Aircrew Against Conventional Weapons *Para 1. General:* Requirements for provision of effective ballistic protection for aircrew, and are additional to Chapt 112. *Para 2. Design:* Shield crew with structure and non-critical components. Separate multiple pilot stations. Protection systems not to interfere with operations. Choose most appropriate materials for each location. Do Casualty Reduction Analysis. Consider performing tests to verify level of protection. Testing to be agreed with APD. *Para 3. Armour:* Integral armour to meet all design requirements. If armour is in seat, it is to be considered in Chapt. 307 considerations. Do not use materials that generate spall particles, unless these are contained. *Para 4. Reduction of vulnerability to battle damage:* Any equipment specifically required is to be included in Aeroplane Specification.
Leaflet 114/1 General Requirements *Para 1. General:* Non-mandatory requirements, background information and advice on crew protection systems. *Para 2. Design:* Crew protection will be achieved by design. Separation, shielding and armour to be considered. Systems to be used will be determined by Chapt. 112 Vulnerability Analysis. *Para 3. Armour:* Indicates parameters that affect effectiveness of armour on crew, effectiveness of material as armour, and the types of armour.
Chapter 115 Night Vision Goggles Lightning Compatibility Design Criteria Not relevant to composite structure.
Chapter 116 Not Used Not relevant to composite structure.
Chapter 117 Design Criteria for Aeroplane Equipment, Systems and Installations Not relevant to composite structure.

PART 2 STRUCTURAL STRENGTH AND DESIGN FOR FLIGHT

Chapter 200 Static Strength and Deformation

Para 1. Introduction: Chapter states requirements for static strength and freedom from deformation. Identify all Grade A details and an allowable strength or stress, normally on a B-basis.

Para 2. Design Cases: Use a limited number of defined design cases (given in other Chapters of Def Stan 00-970). Identify critical design cases and trace load paths far enough to ensure requirements satisfied everywhere. Must demonstrate compliance with Def Stan 00-970 and any more demanding cases.

Para 3. Ultimate strength and proof requirements: Ultimate and proof factors normally 1.5 and 1.125. No Grade A item shall sustain deformation detrimental to safety until DPL (=1.125 DLL). After removal of DPL no effects of loading shall remain. Until DUL exceeded no Grade A item shall collapse, or the stress, load or strain exceeds the static allowable.

Para 4. Substantiation of static allowable stress for Grade A details: Determine allowables under most adverse loading and environmental conditions, at the most adverse moisture level expected through the life. Allowables derivation to be based on B values (Def Stan 00-932 or 15 specimens) and acceptable structural analysis. Exceptionally may get allowables from individual batches. Structural analysis method must be substantiated by test if not already done. At least one specimen required to verify analysis.

Para 5. Demonstration of compliance with the ultimate strength proof requirements for complete structures or components: Must usually demonstrate compliance by testing complete structure to DUL. Must allow for variability in test result, or uncertainty if test not done. Program must be discussed with APD and Airworthiness Division RAE (AD RAE).

Para 6. Measurements of loads on aeroplane structures: Agree with APD & AD RAE on extent of load and temperature measurement to be done on early development aeroplane.

Para 7. Definitions: Definitions for coupon, structural detail, DLL, DPL, DUL, static test factor and static allowable stress.

Para 8. Engine and auxiliary power unit mounting loads: Mountings and related structure shall have sufficient strength and rigidity to withstand specified flight and ground testing. Consider all forces from thrust, torque, gyroscope couples, inertial forces, aerodynamic forces, airloads, structural flexibility and thermal effects.

Para 9. Reduction of vulnerability to battle damage: Structures should be designed to resist battle damage and be easily repairable. Drain holes and drip fences provided wherever possible.

Para 10. Considerations in setting permissible flight loads for experimental and prototype aeroplanes:

Leaflet 200/1 Principles underlying the requirements

Para 1. Introduction: Leaflet outlines basic principles of strength and deformation requirements and why requirements are sometimes proof loads and sometimes ultimate loads.

Para 2. The ultimate strength and proof requirements: Enormous variation of loads in service aeroplanes. Design cases chosen to demonstrate compliance because they are severe. Uncertainty in actual loads requires that DUL greater than DLL. Material strength variability accounted for by using B allowables, test factors, environmental degradation allowance. Tests should be continued until the real proof load is found. This is the load to which the airworthiness can be depended on.

Para 3. Special cases: Although both are important, there is usually a margin over either the strength or deformation. Nevertheless compliance with both must be demonstrated. Some cases given (deformation around ejection seats, or strength of seat harnesses) where either criterion may dominate. Accordingly these situations have different requirements.

Para 4. Comments: The diverse nature of strength requirements requires different proof and ultimate factors. This outweighs the convenience of uniform factors.

Leaflet 200/2 Static structural strength test loading sequence

Para 1. Introduction: Leaflet describes the aims of conducting the static test programme. These should be kept in mind when planning the programme.

Para 2. Test aims: Aim is to gather as much information as possible from each specimen. Aim to verify structural analysis, establish proof load, show that all Grade A items are identified.

Para 3. Recommended test procedure: Incremental loading to DPL in each critical case. At DPL check functionality. Remove load. Inspect. Load/check/unload/inspect above DPL in suitable increments. Continue until real proof load found. Demonstrate a defined test factor on DUL. Repeat for each of the other selected loading cases.

Para 4. Notes: Aim of test is to gain as much data as possible, especially for determining maximum speed and acceleration. Leaflet does not cover fatigue. Definition of structural distress is vague. To be sharpened with experience.

Leaflet 200/3 Engine and auxiliary power unit mounting loads

Para 1. Introduction: Describes the sources of loads on the airframe, resulting from the engines, and how to calculate their direction and magnitude and reasons for the chosen engine power condition. Loads originating from the engine and aeroplane manoeuvres are described. May be needed to calculate loads for design cases.

Para 2. Engine and propeller types: Indicates the types of engines and propellers in current use.

Para 3. Engine loads: Describes parameters, and the effect of; engine thrust, torque, gyroscopic couples, inertia forces, effects of asymmetric airflow.

Para 4. Aeroplane manoeuvres: Indicates how to calculate critical parameters from; symmetric manoeuvres, gust effects, spinning, take-off, yawing, propeller reverse thrust, landing, sideload, excess torque and engine mounts.

Para 5. Summary: Gives table of basic conditions of the stress cases that may be critical to the engine mounting.

Leaflet 200/4 Strength of structures under conditions of heating and cooling

Para 1. Introduction: Must account for differential expansion, temporary and permanent loss of strength, and creep, when temperature changes. Leaflet recommends design methods and safety factors for use when thermal effects are significant.

Para 2. Thermal stress and strain: When elements of a structure have different α, or are subject to different T, the equilibrium length change for these parts will be different when the temperature changes. The final length of these elements will satisfy geometrical compatibility and equilibrium of internal forces. This results in thermal stresses in the elements.

Para 3. Calculations: (i) determine temperature distribution, may need a variety of sources. (ii) calculate stresses and strains. Must allow for material and joint variability. Determine this by test wherever possible. (iii) If total stress from thermal and external loads is below elastic limit then stresses/strains can be calculated separately and superimposed. If total stress exceeds elastic limit then stresses/strains are interdependent and should be calculated simultaneously.

Para 4. Factored conditions: A safety factor on thermal effects is required since calculation of thermal stresses is at least as inaccurate as that for external loads. Acceptable methods for calculating total factored strain given. Relations depend on whether thermal loads reinforce or cancel external loads.

Para 5 Design cases: Examine all conditions where combined applied loads and thermal strains likely to produce critical structural loads. Gives two defined design cases.

Para 6. Thermal effects on materials: The material properties used should account for thermal effects and history. Consider high and low temp, and whether they aggravate or relieve applied loads. Wherever practicable use materials that do not suffer a substantial reduction in properties at temperatures slightly higher than that corresponding to the design speed.

Para 7. Ground tests: When strength tests including thermal effects are required to demonstrate compliance, the factored load and, if practicable, the factored thermal strain should be applied. The method of simulating thermal strain to be discussed with APD (& AD RAE). Must account for differences between component and full-scale loads.

Para 8. Instability failures: Must account for the possibility of thermal strains causing instability and structural collapse under low external load.

Leaflet 200/5 Considerations in setting permissible flight loads for experimental and prototype aeroplanes

Para 1. Introduction: Can flight test new designs before the total structural certification program is completed. Leaflet gives acceptable restrictions on flight loads for this work.

Para 2. Guidelines for setting permissible flight loads: Benchmarks (i) Test to DUL, substantial analysis and flight loads measurement (FLM) - 100% DLL, (ii) Test flight aeroplane to DLL, acceptable analysis and FLM - flight to 0.87 DLL (iii) Test to DLL, acceptable analysis and FLM - flight to 0.8 DLL, (iv) Analysis with no test data - flight to 0.5 DLL.

Para 3. Considerations in setting permissible flight loads for experimental and prototype aeroplanes: Gives a list of considerations that must be addressed.

Chapter 201 Fatigue Damage Tolerance

Para 1. Introduction: Requirements apply to all structurally significant items and composites unless they are fatigue insensitive. Use Safe life approach. Also use damage resistant materials and details to be designed to tolerate increased spectrum severity. Particularly sensitive details to be identified and stresses reduced, or exceptionally may use replaceable parts. Design for ease of inspection and replacement is encouraged, however inspections should not normally be necessary.

Para 2. Safe life details: Safe life details must meet: (i) life under the specified loading and environment at least that of specified life, (ii) safe life with 1.2 load amplification at least half of that in (i), (iii) material to have good resistance to damage growth, (iv) material shall not be susceptible to impact, environment, manufacture and/or maintenance damage.

Para 3. Inspection dependent details: A detail may be inspection dependent, if economic and operational consequences acceptable. To enable assessment must establish: (i) safe life under anticipated and amplified loading, (ii) likelihood of damage by impact, maintenance, environment or manufacture, (iii) damage growth curve for anticipated and amplified loading, (iv) inspection technique reliability curve, and (v) maximum inspection interval under each loading condition.

Para 4. Service monitoring: Estimate fatigue life consumption of significant details in every aeroplane using acceptable instrumentation. A few aeroplanes to have comprehensive instrumentation to measure loads on major structural components in each aeroplane role.

Para 5. Demonstration of compliance: By calculations supported by tests on details, sub-assemblies and the structure. Two airframe tests required for new projects (i) pre-production airframe completed in time for changes to be incorporated in production, (ii) on a production structure, preferably under actual service loading. Continue both tests to five times specified life or specimen no longer representative. After fatigue testing complete need to do residual strength test, residual stiffness test (where relevant) and tear down inspection. Results to be fully reported in Fatigue Type Record (FTR) (ref Def Stan 05-123 Chapter 333). All procedures and judgements to be approved by APD (& AD RAE).

Para 6. Compliance of aeroplanes not designed to DEF STAN 00-970 (See also Part 2 Appendix 1 Para 4): In some cases will need an assessment to show compliance with this Chapter if aircraft was not been designed to DEF STAN 00-970. Leaflet 201/8 describes the procedure. The extent of the assessment shall be agreed with the APD.

Para 7. Definitions: Defines the types of lives (specified, equivalent, safe, test life factor), structures (structural detail, safe life detail, etc.), and inspection (system, interval, etc.)

Leaflet 201/1 Main features of the requirement

Para 1. Introduction: Aim of requirement is to provide a good safe life. Leaflet describes acceptable procedure for estimating life and establishing compliance. May adopt inspection-dependent approach. Calculations required to identify fatigue sensitive items and show their life is at least half specified life when load amplified by 1.20. Compliance normally demonstrated by test supported by calculations. FTR has (i) design philosophy, (ii) formal fatigue substantiation, and (iii) running fatigue substantiation. Mainly refer to metals but applies equally to composites unless they are shown to be fatigue insensitive.

Para 2. Material selection: Materials should have good resistance to crack growth. Crack propagation rate and fracture toughness are the indicators. Exceptionally may have materials with a low rating in agreement with APD (& AD RAE). See Leaflet 201/2 for guidance.

Para 3. Substantiation of fatigue life: Recommend a "Safe S-N curve" be constructed. Apply factors to account for specimen and loading variability and shape of curve. See Leaflet 201/3.

Para 4. Substantiation of damage growth and associated inspection procedures: Inspection-dependent parts allowed for economic and operational reasons. Crack growth for metals determined by LEFM. Need to determine inspection intervals. See Leaflet 201/4 for guidance on acceptable means of compliance.

Para 5. Fatigue damage tolerance testing: Compliance with Chapter 201 to be supported by testes. Pre-production fatigue test for identification of shortcomings. Provided no problems, do production fatigue test with operational spectrum. Residual strength and tear down to be done. Leaflet 201/5 has an acceptable test programme.

Para 6. Service monitoring: Leaflet 201/6 provides acceptable procedures for fleetwide monitoring and operational loads measurement.

Para 7. Service beyond the specified life or an equivalent life: Need to reassess structurally significant items to justify any life extension. May require additional testing and/or stricter controls. Guidance on topics to be considered given in Leaflet 201/7.

Leaflet 201/2 Material selection

Para 1. Introduction. Refers only to the selection of metallic materials. Guidance is given on the parameters that should be considered in the assessment of damage tolerance qualities.

Leaflet 201/3 Substantiation of fatigue life

Para 1. Introduction: a balanced programme of calculations and tests on elements, sub-assemblies and major components will normally demonstrate Compliance. Need to include environmental effects. Guidance given on the various allowances required.

Para 2. Allowance for scatter in fatigue performance: Considerable scatter in life or nominally identical specimens. Use Bullen approach to account for this. Technique given to construct safe life S-N curves for metals, which incorporates different factors for life and stress. Use safe life S-N curves of details to calculate test life factor for whole structure. This is typically 3 to 5 (explains why full scale fatigue tests taken to 3 lifetimes).

Para 3. Derivation of loading spectra for calculations and tests: Gives acceptable techniques to estimate fatigue spectrum from structural/aerodynamic models. Indicates possibilities for accelerating tests, and precautions to prevent non-representative results. Generally aim for a realistic sequence to be applied 40 times over the test.

Para 4. Allowances for uncertainties in service loading: Customary to use factor of 1.5 on life in steep part of S-N curve and 1.2 on stress in flatter part to allow for loads uncertainty.

Para 5. Allowances for uncertainties in calculations: Describes procedure to allow for uncertainties when (i) adjusting test loading endurance to that for service loading (table of factors given), and (ii) estimating life of details based on constant amplitude S-N data for relevant test elements (recommend dividing estimated safe life by factor of 3).

Para 6. Summary of allowances to be made in substantiating fatigue life: Gives conditions for excluding the different factors. If environment effects fatigue sensitive parts, and these are not reproduced in major fatigue test, must have a supporting test programme.

Leaflet 201/4 Substantiation of damage growth and associated inspection procedures

Para 1. Introduction: Leaflet gives life reduction factors due to uncertainties in derived crack growth curves (da/dN vs. ΔK) for metal details. Damage growth curve of composite structures should be determined by test. Guidance given on calculation of residual strength and defining the inspection system. Inspection procedures apply equally well for composites.

Para 2. Derivation of crack growth curves for metal details: Derive curve from threshold to critical size. Account for mean stress, threshold stress intensity factor and K_c of specimen.

Para 3. Uncertainties in crack growth curves: Following two paras deal with two possible circumstances.

Para 4. Interpretation of calculated adjustments of component test data to allow for a change in the severity of service loading: Can increase confidence that da/dN can be predicted for a new (service) spectrum if can predict test results to within 50 %. If this is not done then need to check for sources of error.

Para 5. Allowances for uncertainties when average crack growth curves are based upon calculations alone: da/dN vs. ΔK to be reduced by factor of 2 in absence of stress measurement and another 2 if approximate geometrical correction for K is used.

Para 6. Allowances for scatter in crack growth life: Will be a distribution of life for nominally identical specimens. Use standard deviation in $\log_{10}$ life of 0.11, or Table from Leaflet 201/3.

Para 7. Allowances for uncertainties in service loading: Use factor of 1.5 on life when service loading is not monitored.

Para 8. Calculations of residual strength and critical crack length: Residual strength not to fall below 0.8 DUL. Critical crack length is that for this strength. Use conservative value based on available data.

Para 9. Performance of inspection systems: Detection probability level affected by (i) probability of damage occurring, (ii) probability of inspecting the detail, (iii) reliability of the inspection process. The overall probability of detection (PD) is normally assigned to 0.999.

Para 10. Determination of damage range and inspection reliability: Must determine critical damage size. This will dictate inspection process. Determine average reliability curve for inspection process, extrapolate to PD = 0. This is threshold size, which should not be less than the minimum damage size for which growth can be reliably forecast.

Para 11. Estimation of time of first inspection and subsequent inspection intervals: Overall PD depends on time of first inspection and interval between inspections. Threshold time is approximately safe life of the detail. Guidance given on determining inspection intervals. With a simulation model want overall PD > 0.999, without model PD = 0.5.

Para 12. Non-propagating damage: Non-propagating damage occasionally occurs. Set intervals and inspection to give an overall PD. These must be acceptable to APD (& AD, RAE).

Leaflet 201/5 Testing

Para 1. Introduction: Fatigue and residual strength testing required to demonstrate compliance. Format must be agreed with APD. Core is the two full-scale fatigue tests, the first to identify major shortcomings in design and second to establish the fatigue life under service loads. Major tests are to be supported by supplementary tests. In some exceptions there may be no need for the tests.

Para 2. Design development tests: Done to provide data for material selection and design, and to eliminate uncertainty in analysis. Must also determine environmental effects by test at element or coupon level unless suitable evidence available. Element and component tests to give confidence in fatigue and damage growth data. Use spectra with 1.20 load amplification. Need to test at a level that gives representative constraint on the specimen. Special need to test details that are uninspectable.

Para 3. Pre-production fatigue tests: Full-scale fatigue test on initial production standard airframe or major components provided loading is representative. Should include all main load paths. Should use anticipated spectra. Include any environmental conditions that cannot be catered for by a margin on life. Use strain gauges to correlate test and flight measurements. Test to at least three times specified life. Conclude with stiffness tests, residual strength if appropriate and finally a tear down inspection.

Para 4. Production fatigue tests: Determine fatigue life of the structure. Specimen should be structurally complete and representative of those in service. Supplementary tests on details that cannot be adequately loaded in full-scale test. Utilise service-measured spectra. Strain gauge specimen to ensure loading is representative of operational loads. Continue test for five times specified life. Repair or modify test specimen as per service aircraft. Need to demonstrate damage growth characteristics for details which the test and analysis have shown a need. Conclude with stiffness tests, residual strength if appropriate and finally a tear down inspection.

Para 5. Test accuracy: Test loads to be applied to ±3% of max demanded load. More important to know actual loads. Measure strains to determine dynamic strain effects.

Para 6. Residual strength tests: Strength to be >0.8 DUL after the fatigue test. Loading conditions to be agreed with APD (& AD, RAE). Test should be used to confirm critical damage sizes. Detailed procedure must be agreed with APD (& AD, RAE).

Para 7. Tear down inspection: Done to identify damage that was not detected during the test. Completely dismantle load carrying structure and inspect.

Leaflet 201/6 Service monitoring

Para 1 Introduction: Use fleetwide monitoring to maximise fatigue life of each airframe accumulate data to support fleet management. OLM to identify service not accounted for in design, warn of design load exceedences and aid future design.

Para 2. Fleetwide recording: Record parameters so that the most damaging loading action on the component can be identified. Agree with APD and Services on additional data to be recorded. Review data after each flight. Use it to; check exceedences, time inspection/modification and safe-life withdrawal. May use Fatigue Index (FI) to measure fatigue history. Fatigue meter is simple instrument to measure exceedences. Formula to calculate corresponding FI must be agreed with APD (& AD, RAE).

Para 3. Operational loads measurement: Comprehensive operational loads measurement to be done on a few aircraft. Calibrate OLM strain sensors in test rigs. Get representative sample of each type of sortie flown by each squadron. To reduce costs rotate instrumented aircraft through appropriate squadrons. OLM compliments fleetwide recording.

Leaflet 201/7 Operation beyond the specified life or an equivalent life

Para 1. Introduction: Structure to be assessed to identify any additional details that have become critical because of life extension.

Para 2. Safe-life details: In general these parts cannot exceed the life that has been substantiated by test and/or calculation and must be replaced. Check sensitivity to increased loading severity. May be able to gain extra margins. Exceptionally, if an acceptable inspection system can be found, it may be possible to re-qualify parts as inspection dependent.

Para 3. Inspection-dependent details: Calculations, assumptions, test data and service history should be reviewed. Consider more extensive damage models than original crack growth calculations. Consider re-working parts to extend their life. Consider additional testing if existing data is insufficient.

Para 4. Life extension document: Place review in Fatigue Type Record. Implement recommendations such as stricter existing inspections and additional inspections.

Leaflet 201/8 Clearance of aeroplanes designed and developed to airworthiness requirements other than Def Stan 00-970 *Para 1. Introduction:* Leaflet gives analytical procedure that will clear aeroplanes to Chapter 201 requirements. Other factors such as static strength also have to be examined. *Para 2. The clearance procedure:* Require accurate and valid service spectrums that have been validated. Produce a report detailing all aspects of fatigue life, for APD (& AD, RAE). *Para 3. The reviews:* Step-by-step reviews of existing design to establish fatigue life in relation to requirements of Chapter 201. Review; design criteria, specification and airworthiness requirements, compare airworthiness data with DefStan, design spectrum, test spectra, structural configuration and loading of test specimen, test results and tear-down inspections, airframe life, materials for resistance to crack growth, UK service 'special to type' modifications, inspection schedule, in-service experience of other operators. *Para 4. Structural compliance:* Collate review and deviations. Recommend additional testing requirements. *Para 5. Operational limitations:* Recommend any flight-testing required before OLM programme to the APD. *Para 6. Additional analysis and testing:* Complete any additional analysis and testing and report to APD on fatigue and damage tolerance of the aeroplane. *Para 7. OLM and fatigue monitoring programme:* Derive OLM programme from previous tests. Need to correlate OLM with previous records. Derive fatigue-monitoring programme. *Para 8. Structural integrity inspection schedule and fatigue record type:* Update structural integrity schedule and prepare fatigue type record. *Para 9. CA release data:* Complete data and supporting documentation for promulgation by APD.
Chapter 202 Symmetric Manoeuvres *Para 1. Introduction:* The requirements of this Chapter apply to all aeroplane types, and to the aeroplane as a whole in each case. *Para 2. Factors:* The structure shall have a proof factor of 1.125 and an ultimate factor of 1.5 throughout the specified flight envelope, and under specific pitching manoeuvres. *Para 3. The flight envelope:* Structural flight envelope is defined in terms of n versus V diagram and n_1 and V_D. *Para 4. Manoeuvres to be considered:* Steady pitching velocity, and limiting positive pitching acceleration, throughout the flight envelope. *Para 5. Supplementary conditions and assumptions:* Gives the ranges for engine power, high lift devices, airbrakes, undercarriage, mass and mass distribution to be considered.
Leaflet 202/0 References Gives references for two ARC reports on loading conditions for tailed aircraft
Leaflet 202/1 The calculation of the response of an aeroplane to pitch control input and associated loads when a conventional control system is used *Para 1. Introduction:* Chapter 202, para 4, requires rational representation of pitch motivator when evaluating loads. This is complex. Broad outlines given in Leaflet 202/3. Can use analytical techniques when there is a direct link. *Para 2. Manoeuvre conditions:* Consider cases from steady level flight to condition of steady normal acceleration then return to steady flight. Aim is to specify control input that leads to maximum normal acceleration. *Para 3. Pilot input:* Can specify motivator movement in terms of pilot's inceptor movement. Defines different types of movements of the pilot's inceptor that are to be considered. *Para 4. Calculation of the response of the aeroplane:* First calculate response of aeroplane to inceptor movement. Then determine increment in control surface angle of incidence making due allowance for relevant factors. *Para 5. Control/stabiliser surface loads:* Gives components of load on a control surface. Describes the sequence of loading, from maxima to steady state values, during pitching manoeuvres for different layout aircraft. *Para 6. Control surface hinge movements:* Describes factors influencing, and behaviour of, the moment about a hinge line. *Para 7. General remarks:* Gives assumptions for cases where analytical solution possible. Can estimate some of the data required in Chapter 202 if it is not available.
Leaflet 202/2 Definitions *Para 1. Introduction:* Gives definitions recommended for general use. Avoid undefined terms is official reports. *Para 2. Acceleration:* Defines normal acceleration coefficient and maximum normal acceleration coefficient. *Para 3. Powered flying controls:* Whole or part of power for a surface is provided by non-human source(s). *Para 4. Speed:* Defines design diving speed, V_D, and minimum permissible speed.

Leaflet 202/3 The calculation of the loads associated with symmetric manoeuvres for aeroplanes having control systems with load limiting devices

Para 1. Introduction: The application of techniques described in Leaflet 202/1 is inappropriate. Need to refer to Chapter 208, para 4. Use of simple expressions for movement of motivators is not appropriate.

Para 2. Manoeuvre parameters: One way to proceed with design of airframe and control system is via a set of manoeuvre parameters. These are defined by the role of the aircraft. Refer to Leaflet 208/4 for structural implications.

Para 3. Normal acceleration/pitching acceleration envelope: Normal acceleration and pitching acceleration envelope is a useful measure. Defines these quantities and shows a typical plot.

Para 4. Maximum combination of angular rates and accelerations: Need to consider combination of maximum angular accelerations and to specify the combinations of pitching velocity and normal acceleration.

Chapter 203 Asymmetric Manoeuvres

Para 1. Introduction: The requirements of this Chapter apply to all aeroplane types, and to the aeroplane as a whole in each case.

Para 2. Factors: The structure shall have a proof factor of 1.125 and an ultimate factor of 1.5 (Chapter 200 para 3), unless agreed by APD (&AD, RAE), for the following cases.

Para 3. Manoeuvres to be considered: Cases in paras 4 to 7 of this Chapter.

Para 4. Yawing manoeuvres: Gives the design cases. Want loads from prescribed instantaneous deflection, before aeroplane responds, at maximum sideslip and equilibrium sideslip. Have prescribed corrections for cross-coupling effects.

Para 5. Effects of asymmetric engine failure: Multi-engine aeroplanes shall be designed to withstand the loads that may arise from the sudden failure of the critical engine.

Para 6. Rolling manoeuvres: Loads arising from rolling manoeuvres are covered in the combined rolling and pitching para. Gives roll design cases to consider.

Para 7. Combined rolling and pitching: Consider combined application of roll and pitch motivators at all speeds up to V_D.

Para 8. Bomb bay and door loads: Flight load cases are applicable to bomb bay doors in all positions. Loads shall be determined by full scale or wind tunnel test. Consider buffet effects.

Para 9. Mass and mass distribution: Consider all masses from minimum to maximum (as per Chapter 202, para 5.5)

Para 10. Aerodynamic coefficients and derivatives: Relevant aerodynamic coefficients and derivatives shall be based on the best available data. Validate with flight or wind tunnel tests.

Leaflet 203/0 Reference page

Gives references for a RAE report on loading due to yawing manoeuvres

Leaflet 203/1 Yawing, sideslipping and rolling motions

Para 1. Introduction: Leaflet gives explanation of requirements of Chapter 203 and outlines method of determining critical stressing conditions for these manoeuvres. Complex analysis required on most modern aeroplanes.

Para 2. Lateral manoeuvres arising from applied yawing moments: All yawing tends to induce combination of yawing, sideslipping and rolling. Calculate response as per paras 4 & 5 for simple aircraft. General case must also include dynamics of control system.

Para 3. Yawing control inputs: Must consider, and try to limit, effect of very powerful yaw motivator(s) producing high loads.

Para 4. Effects of asymmetric engine failure: Implication of corrective action specified in Chapter 203, para 5.4, needs to be considered if asymmetric engine failure leads to high loads.

Para 5. The estimation of loads on the directional stabiliser/control surface: Calculate angle of incidence of locations using data obtained in para 2. Also need to calculate corresponding deflection of yaw motivator.

Para 6. Loads on horizontal tail stabiliser/control surface in yawed flight: Loading conditions specified in Chapter 203, para 4.4. Pitching moment coefficient to be increased to allow for sideslip. Resulting trim load must be asymmetric. Defined parameters should be verified by test.

Para 7. Combined rolling and pitching manoeuvres: Defines roll inputs for stressing. Gives acceptable assumptions for manoeuvres described in Chapter 203, para 7. Gives parameters that control loads.

Para 8. General remarks: the loads caused by sideslip on other structures needs to be evaluated using wind tunnel testing. Engine mounts must be designed to account for gyroscopic effects on engine and propeller.

Leaflet 203/2 The calculation of the loads associated with asymmetric manoeuvres for aeroplanes having control systems with load limiting devices

Para 1. Introduction: Techniques from Leaflet 203/1 are inappropriate in ACS aircraft with load limiting devices. Need to refer to Chapter 208, para 4, and Leaflet 208/4. Manoeuvre parameters are an acceptable tool for design.

Para 2. Lateral acceleration/yawing acceleration envelope: For ACS aircraft it is useful to consider envelope that describes interaction of lateral acceleration and yawing acceleration.

Para 3. Combined pitching and asymmetric manoeuvres: Design load cases for conventional aircraft defined in Chapter 203, para 7. Situation is complex for ACS aircraft. Defines lateral manoeuvre parameters that are useful to consider.

Para 4. Maximum combination of angular rates and accelerations: Need to consider the combination of maximum angular acceleration with angular rate for roll and yaw motion. Refers to diagrams showing typical envelopes.

Chapter 204 Gust Loads

Para 1. General: The aeroplane shall have adequate strength for any gusts encountered from vertical, horizontal and intermediate directions that provide critical loading conditions.

Para 2. Factors: The structure shall have a proof factor of 1.125 and an ultimate factor of 1.5 for each of the defined gust cases.

Para 3. Design conditions: Aeroplane assumed to be in unaccelerated flight. Must consider all masses from minimum to maximum. Trim is unchanged during gust.

Para 4. Discrete gust cases: Defines parameters for gusts at V_G, V_H and V_D. Defines these speeds. In addition must consider gusts at all speeds above the static stall boundary.

Para 5. Design analysis: Undertake dynamic response analysis to account for aero-elastic effects and varying gust gradient. For horizontal stabilisers must add gust load to trim load.

Leaflet 204/0 Reference page

Gives references for ARC and NACA reports on various conditions related to wind gusts.

Leaflet 204/1 Safe speeds for aeroplanes flying in turbulent weather

Para 1. Introduction: Leaflet outlines type of investigation required to determine the conditions for least risk of structural damage or loss of control due to gusts. Outcome will be used as basis for advice to pilots.

Para 2. Safe speed-altitude envelope: Defines the risks associated with gusts at low and high altitude. Defines the types of gusts to be considered as a function of altitude, and the representation of the safest speed.

Para 3. Strength boundary: Corresponds to the achieved strength resulting from defined strength requirements.

Para 4. Control and buffet boundary: Loss of control boundary is only an indicator of conditions for control difficulties in severe turbulence. Describes boundary for different flight conditions.

Para 5. Variation of safe speed with altitude: Describes safest speed for different flight conditions.

Para 6. Operational considerations: Operational considerations may preclude flight at the safest speed. A compromise is necessary. Describes the factors that should be considered when making this compromise.

Leaflet 204/2 A method of calculating gust loads for preliminary design purposes

Para 1. Introduction: Leaflet provides a method of calculating gust loads for conventional aircraft in the absence of other data.

Para 2. General: Gives assumptions and loading relation.

Para 3. Gust alleviating factors: Defines alleviating factors for vertical and lateral gusts on subsonic and supersonic flight.

Chapter 205 High Lift Devices and Airbrakes

Para 1. General: Requirements are applicable to the devices, their operating mechanism and all parts of the airframe affected by the load cases. Attention drawn to Chapters 201 and 500.

Para 2. Factors: The devices, their operating mechanism and attachment structure shall have a proof factor of 1.125 and an ultimate factor of 1.5 for each of the defined loading cases.

Para 3. High lift devices: These are auxiliary surfaces used to augment lift during take-off, approach, landing or en-route in combat. Mechanisms must be able to raise and lower the devices at the defined design speeds. Rising must be slow enough to prevent excessive sink. Strength of devices must be considered, and be shown to be sufficient to meet all load cases, when retracted and extended. Mechanical interconnection required if Chapter 604 cannot be met with asymmetric deployment. Proof and ultimate factors of 1.0 and 1.33 required on mechanical interconnections.

Para 4. Airbrakes: Time of extension and retraction is defined. Strength shall be adequate for all design cases in all positions that can be selected in flight. Mechanical interconnection required if requirements of Part 6 cannot be met without it. Proof and ultimate factors of 1.0 and 1.33 required on mechanical interconnections.

Chapter 207 Spinning and Spin Recovery

Para 1. General: Gives design and strength requirements for spinning including entry and recovery. Applicable only to aeroplanes required to recover from post stall gyration or spin.

Para 2. Strength requirements: Ultimate factor of 1.5 shall apply to whole aeroplane under loads arising during spin, entry and recovery. Proof factor of 1.125 applies to Class I and Class IV (Chapter 600, para 3) aeroplanes. Spinning conditions used for calculations shall be those that give the most adverse yaw, pitch and roll components of rotation. Leaflet 207/1 gives acceptable means of estimating rotation rate. In each phase must consider all possibilities of engine power and stores.

Chapter 208 Active Control Systems

Para 1. General requirements: Chapter contains requirements relating to flight with active controls. Concerned primarily with the systems that operate continuously.

Para 4. Airframe aspects (see also Leaflet 208/4): Aim of requirements is that aeroplanes with and without ACS have the same level of structural integrity. Requirements are subject to approval of APD (&AD, RAE). There will be more critical flight conditions in ACS aeroplanes, the principles of determining these are in Leaflets 208/3 and 4. Prototype, development, and production aeroplanes, will be instrumented to measure critical static and fatigue loads. May need to modify design to cope with unexpected loads.

Para 7. Applications (See also Leaflet 208/1): Specific ACS roles that may affect structural integrity include; manoeuvre load alleviation, gust load alleviation, structural load limiting. Must ensure the failure of these systems does not overload structure.

Para 8. Definitions:

Leaflet 208/4 Structural implications of ACS

Para 1. Introduction: Leaflet provides guidance on acceptable means of compliance with Chapter 208, and related Chapters 200, 201 and 500.

Para 2. General design considerations: ACS used either to enhance performance (eg carefree manoeuvring) or alleviate loads (eg flutter suppression). Unlikely that design analysis alone will define all critical load cases. Aircraft usage to be probed to identify potentially hazardous loading actions. Need in-service confirmation of load levels. Consider full range of ACS serviceability. Establish, for multi-axis inputs and gusts, that small input in control function will not increase load from DLL to DUL.

Para 3. Combat aeroplanes: Special attention to be given to defining fatigue spectra, since it tends to be frequently at high end of loading. Aircraft to be flutter free to at least $1.15V_D$. If ACS inoperative flutter speed may be less that V_D provided pilot can safely get to stable condition.

Para 4. Transport aeroplanes: Permissible, provided Chapter 208, para 4.2.1 met, to take full advantage of gust alleviation system. This may result in unconventional sizing of structure. Flutter speed should never be less than V_D, even if ACS inoperative.

Chapter 209 Airframe Design to Resist Birdstrike Damage

Para 1. Introduction: Specifies minimum requirements for resistance of airframes to damage caused by birdstrike in the European theatre of operation.

Para 2. Basic operational requirements: The effect of a single defined birdstrike shall not degrade flying qualities below level 2. Consideration shall be given to minimise the cost of repairing birdstrikes in defined areas. Acceptable repairability shall be demonstrated. Repair by replacement is acceptable subject to agreement of APD.

Para 3. The threat: Maximum threat is a 1.0 kg bird at V_M (but <480 Kt TAS). Defined locations are frontal aspects of; windscreen and forward facing transparencies, front fuselage structure, engine air intakes, leading edges and aerodynamic devices mounted on leading edges. Consider straight and level flight and max yaw and pitch angle relevant to V_M.

Para 4. Detailed requirements: Detailed list of the type of damage allowed, eg. penetration, deflections, deformation, cracking, etc, for; transparencies and supporting structure, front fuselage, intakes, frontal aspects of flying surfaces, aerodynamic devices on leading edges, and systems.

Para 5. Testing: The mode and extent of testing shall be established by agreement between the APD and contractor.

Chapter 210 Radomes

Para 1. Introduction: The general requirements are given in Chapter 708. It is accepted that good radome design will be a compromise between electrical and structural properties.

Para 2. Requirements: Structural requirements include those for static strength and stiffness, fatigue, hail and bird impact and lightning strike. Must get APD approval if radome will not meet any of these. For design cases that give structural failure of radome, must ensure aeroplane integrity is not impaired. Acceptable to use "disposable radomes".

Leaflet 210/0 Reference page

Gives references for MIL SPEC's related to aircraft structures and radomes.

Appendix No. 1 Structural strength and design for flight for military derivatives of civil aeroplanes

Para 1. Introduction: Describes differences between requirements of Def Stan 00-970 and other airworthiness requirements in terms of the additional requirements needed of civil aeroplanes if they are to be accepted for military applications. There are some significant differences and this section will provide a useful reference.

Appendix No. 2 U.S. Military Specifications, Standards and Handbooks

Table: Gives the Def Stan 00-970 Chapter and Leaflet titles, then the US specifications, standards or handbooks relevant to that section.

PART 3 STRUCTURAL STRENGTH AND DESIGN FOR OPERATION ON SPECIFIED SURFACES
Chapter 300 Design of Undercarriages - Operational Requirements Not relevant to composite structure.
Chapter 301 Design of Undercarriages - General Requirements Not relevant to composite structure.
Chapter 302 Design of Undercarriages - Directional Control of the Aeroplane on the Ground Not relevant to composite structure.
Chapter 303 Design of Undercarriages - Nose Wheel Steering Not relevant to composite structure.
Chapter 304 Design of Undercarriages - Landing Not relevant to composite structure.
Chapter 305 Design of Undercarriages - Operation from Surfaces Other Than Smooth Hard Runways Not relevant to composite structure.
Chapter 306 Design of Undercarriages - Retraction and Lowering Not relevant to composite structure.
Chapter 307 Crash Landing, Ditching and Precautionary Alighting on Water *Para 1. General:* Aeroplanes divided into Cat. A - with ejection seats, Cat. B - light aeroplanes without ejection seats, Cat. C - Transports. Objective is to preserve the lives of crew, minimise aircraft damage and ensure ejection capability. The systems that contribute to occupant protection must be considered as part of an integrated design. *Para 2. Design for crash landing, ditching and precautionary alighting on water:* Gives requirements for; evacuation, protective shell design, strength and energy absorption, materials and controls. These facilitate exit or minimise injury to crew. *Para 3. Design for ditching and precautionary alighting on water:* Applies if required in Aeroplane Specification. Design aeroplane to allow ditching, flotation in the defined sea state and escape. *Para 4. Design for crash landing:* Additional requirements for Category B aeroplanes. Gives design requirements for longitudinal, vertical, lateral and combined impact, roll over, seats, equipment, cargo, stretchers, harnesses and evacuation. *Para 5. Design of systems:* Aeroplane and systems to be designed to minimise probability of fire upon impact. Fuel system to be designed to contain fuel during and after crash. *Para 6. Validation of design:* Demonstrate by static and dynamic test and by modelling. Consider need for full-scale tests. *Para 7. Reliability:* High degree of reliability required. Design authority to propose tests to insert in Aeroplane Specification. *Para 8. Applicability of Tables 1 to 13:* Tables give design and test cases, limits of human tolerance, seat accelerations. The category of aircraft to which each applies is indicated.
Leaflet 307/0 Reference page Gives references for papers related to crashworthiness.
Leaflet 307/1 Definitions Gives definitions for alighting, normal landing, heavy landing, crash landing, ditching, impact point, survivable crash, effective mass and submarining.

Leaflet 307/2 Design for crash landing and ditching *Para 1. Design:* Describes Chapter 307 para 1 to 3 priorities. Gives some features that improve survivability. Gives guidelines for designing structures to improve their capability to absorb the energy of impact. *Para 2. Tests:* Need some dynamic tests on structure to comply with Chapter 307 para 2.3.2. Ditching model tests required. *Para 3. Repairability:* Design should provide for modular replacement of energy absorbers after survivable accidents. *Para 4. Windshear effects and ejection:* Need to ensure ejection seat functions correctly after a heavy landing. Dynamic analysis needed to establish crash vectors. *Para 5. Supplementary dynamic analysis:* Aeroplane specification may require additional cases for dynamic analysis in addition to those of Chapter 307 para 6. Defines cases and some of the applicable conditions. *Para 6. Trade-off studies:* Studies from Chapter 307 para 4.9.5 may reveal that static strength factors need to be higher than those specified in Chapter 307. *Para 7. Attachment and restraint of components, equipment, cargo and freight:* If the strength, attachments or local support of items from Chapter 307 paras 4.9.2 and 5.1.2 does not meet requirements, they may be restrained. *Para 8. Strength of energy absorbers:* Describes the use of data presented in Chapter 307, Tables 3, 4 and 6. *Para 9. Vertical impact:* Defines design features recommended to support Chapter 307 para 4.3. *Para 10. Undercarriage lay-out and design:* Design and positioning of undercarriage is important in maximising energy absorption. Should be designed to collapse in an energy absorbing manner. Skis should not snag on rough ground. *Para 11. Earth scooping:* Conditions of Chapter 307 para 4.2.3 may lead to roll over. Gives features to avoid this. *Para 12. Buckling of structure:* Describes features to comply with Chapter 307 para 2.2.1 and minimise hazards to occupants. *Para 13. Head strike envelope (See also Chapter 106 para 7):* Should be determined in all axes. Describes recommended design features to protect the head. *Para 14. Flailing of arms and legs:* Describes features and requirements to minimise injury resulting from flailing limbs. *Para 15. Padding:* Gives requirements for any padding used in accordance with Leaflet 307/2 paras 12 and 13. *Para 16. Control columns:* Describes features of control columns that minimise the risk of impaling occupants. *Para 17. Wings:* Aeroplane specification shall state whether the wing should be frangible. Wing should break off before fuselage collapses. *Para 18. Reliability of seats:* Amplification of Chapter 307 para 7. Defines type of analysis required, life of seat and fabric.
Chapter 308 Strength for Ground Handling Not relevant to composite structure.
Chapter 309 Picketing Not relevant to composite structure.
Chapter 310 Design of Undercarriages – Wheels, Tyres, Brakes and Braking Systems Not relevant to composite structure.
Chapter 311 Ground Clearance Not relevant to composite structure.
Appendix No. 1 Structural Strength and Design for Operation on Specified Surfaces for Military Derivatives of Civil Aeroplanes Not relevant to composite structure.
Appendix No. 2 U.S. Military Specifications, Standards and Handbooks *Table:* Gives the Def Stan 00-970 Chapter and Leaflet titles, then the US specifications, standards or handbooks relevant to that section. Not relevant to composite structures.

PART 4 DETAIL DESIGN AND STRENGTH OF MATERIALS

Chapter 400 General Detail Design

Para 1. General: Variety of materials and parts to be minimised, consistent with structural efficiency. Components and equipment shall have at least the same factor as the main structure.

Para 2. Grading of parts and assemblies: All parts, except standard parts, shall be designated Grade A or Grade B. A part is Grade A if its failure causes defined outcomes (structural collapse, loss of power etc). Interpretations of the requirements are given in Leaflet 400/1. All drawings shall state the applicable quality control requirements.

Para 3. Standard Parts: No other item is to be used to perform functions for which a standard item is suitable. All standard items shall be in accordance with the latest approved issue.

Para 4. Materials and processes: For grade A parts the material and process of manufacture shall normally conform to an approved Aerospace Specification in DEF STAN 00-00 Part 3 (Note that this has been cancelled according to the web page). Must have a Contractor's Specification for Grade A parts from unapproved materials or processes.

Para 5. Strength of materials: See Chapter 401.

Para 7. Locking of threaded fasteners: Standard of locking depends on the grade of application. Grade A applications need means described in Leaflet 400/4 para 2. Some applications require additional means of retention. Indicates limits on locking wire, centre-popping, peening and adhesives. Other techniques can be used by agreement with APD.

Para 9. Use of cold forged steel bolts: When cold forged bolts used in applications subject to fatigue, or cannot relax after torqueing, the bolts are to be to Specification DTD 5162, or as agreed by Director, RAE.

Para 12. Controlled tightening of bolts: Limited to applications where the loss of tightness will result in unacceptable degradation of structural integrity. Indicates types of joints to consider. Drawings to show necessary data.

Para 13. Reduction of vulnerability to battle damage: Cockpit furnishings, paints, finishing's and plastics with good repairability and resistance to NBC effects shall be preferred. Preference to be given to structural materials that are easily repairable. The response of structural adhesives to nuclear, biological and chemical effects shall be considered.

Leaflet 400/1 Grading of aeroplane parts and assemblies

Para 1. Introduction: The Leaflet explains the objectives of the grading system and gives acceptable interpretations of the Chapter 400 requirements.

Para 2. Objectives of the grading system: Purpose is to highlight the consequences of failure of the part and to ensure appropriate care is taken during design.

Para 3. Application of the grading requirements: Part may be Grade A even if only one region is critical. Ensure Grade B parts cannot be substituted for Grade A parts. Defines the considerations when grading parts that may result in; loss of control, failure of motive power, injury to occupants, unacceptable unserviceability or maintainability.

Leaflet 400/3 Controlled tightening of bolts

Para 1. Introduction: Leaflet discusses methods for tightening of parallel shanked bolts.

Para 2. Applications of controlled tightening: Describes the reasons for using controlled tightening in various situations.

Para 3. Method achieving a given pre-load (See references 2 and 6): Describes methods, and the merits, of different tightening techniques.

Para 4. Loss of pre-load: Pre-load falls significantly over time. Critical joints need to be retightened or pre-loaded sufficiently to account for the drop.

Leaflet 400/4 Locking of threaded fasteners

Para. 1: Introduction: Leaflet gives acceptable means of complying with Chapter 400 para 7. Defines threaded fasteners.

Para 2. Standard A locking: Called positive locking and is any method of locking that has been shown to maintain functionality throughout the life of the joint. Describes the preferred and alternative methods.

Para 3. Standard B locking: Defines the methods acceptable for locking threaded fasteners to Standard B.

Para 4. Thread inserts: Thread inserts should not be used if an acceptable alternative is available. May need to be used for repairs.

Para 5. Swarf: Consideration needs to be given to the possible hazards of swarf. Describes alternative if it is a hazard.

Para 6. Environmental effects: Take care to select correct materials where environmental conditions may affect locking.

Para 7. Pipe couplings: Grade A pipe couplings will normally have Standard A locking. Alternative methods may be used if shown to be satisfactory.

Para 8. Further information: DEF STAN 53-32 gives guidance on methods of locking threaded fasteners. DEF STAN 53-90 lists approved self-locking nuts.

Chapter 401 Design Data for Metallic Materials

Not relevant to composite structure.

Chapter 402 Processes and Working of Materials

Para 1. Jointing processes: Covers jointing processes excluding fasteners. Para 1.2 gives factors to be considered when assessing a joining process. Tests may be required to demonstrate soundness of the method. Strength used for design purposes will be based on results from representative specimens, or from previous relevant data.

Para 2. Strength after processing: Sufficient details shall be given on detail drawings to ensure the part is fabricated to the required strength.

Para 4. Flaw detection: The need for flaw detection should be considered. The technique should be agreed between designer and manufacturer.

Para 6. Adhesive bonding: Need to account for all relevant factors; hot/wet environment, aerospace fluids, pretreatment, strength, fatigue and corrosion resistance, complex stress distribution. Structural tests shall be undertaken for all Grade A components unless it can be demonstrated that the proposed application is satisfactory. Corrosion protection to be considered for honeycomb core (Chapter 409).

Para 7. Sealants and sealing: Must get agreement with APD for Grade A applications. Select sealant with due regard to loads, environment, inspection, interfaying with fasteners, leak resistance, surface preparation, seal removal and re-sealing. These are expanded upon in Leaflet 402/7.

Leaflet 402/0 Reference Page

Gives titles and numbers of publications regarding processes and working of materials.

Leaflet 402/2 Adhesive bonding of structural parts – processes and control

Para 1. Introduction: Gives summary of considerations and recommendations affecting the use of adhesives for bonding of structural materials. It is not a process specification.

Para 2. Surface preparation: Must ensure work area is free of and contamination, especially silicones and fluorocarbons. Gives relevant specifications for cleaning and degreasing of metals. For composites swab degrease then abrade to a clean matt finish. Total moisture must be below 0.4 wt %. Preparation details given for honeycomb core.

Para 3. Application of primer and/or adhesive: Strongly recommended to use primer or adhesive within four hours of preparation. APD agreement required if this condition cannot be met.

Para 4. Bonding: Fit of components should produce a glueline, free of gaps and voids, and of substantially uniform thickness. Development components to be used to optimise process.

Para 5. Process control: Complete process schedule, containing all relevant details, is required. Prepare test coupons at the same time as the work piece. Keep full records at all process stages. Coupon tests should be supplemented by periodic testing of specimens cut from components.

Leaflet 402/3 Adhesive bonding of structural parts – recommended design practice

Para 1. Introduction: Gives recommendations on the design and strength of structures with approved adhesives.

Para 2. General design considerations: Requirements for bonding in Grade A structures given in Chapter 402, para 1. Recommended that detailed consideration be given to matching requirements of joint manufacture with the requirements of the joint and component design. Need to consider effects of: differing thermal properties of materials or geometries environmental ageing, honeycomb cores, out of plane stresses, fatigue, electrical connections, load distribution, multistage cure on adhesive in honeycomb core. Simply substituting adhesive bonding for other procedures without a re-design is unlikely to produce a satisfactory design.

Para 3. Choice of adhesives: Certain adhesives are intolerant of multistage cures. This must be checked with the manufacturer and Approving Authority.

Para 4. Strength considerations: Need to perform a detailed load diffusion calculation to predict failing strength of a loaded joint. No simple rules to do this. Peel stress and peak shear stresses cause failure.

Para 5. Temperature considerations: Adhesive joints are temperature/time sensitive. Must allow for; all sources of heating when calculating strength, where practicable obtain strength data from tests, allow for pressure changes in sealed sandwich structures, CTE of adhesive.

Para 6. Handling and manufacturing considerations: Must consider handling and manufacturing. Take measures to control adhesive thickness, support edges with tack rivets, design jigs so that they allow the adhesive to cure under the specified conditions, and protect surfaces that are to be subsequently bonded.

Leaflet 402/7 Sealants and sealing

Para 1. Introduction: Leaflet relates to sealing integral fuel tanks, pressurised zones and in high temperature regions.

Para 2. Definitions: Defines sealant, one part sealant, two part sealant, barrier coating/sealant and overcoating.

Para 3. Materials: Description and advice regarding the applicability and application of polysulphide, fluorocarbon, silicone and fluoro-silicone sealants, nitrile barrier coatings and polyurethane coatings. Para on flammability.

Para 4. Sealing practice: Recommended to assemble all interfaying joints with sealant. Necessary to properly prepare surfaces. May need to remove excess bead. Advice regarding sealing of integral fuel tanks and similar vessels.

Para 5. Form-in-place gaskets and seals: May use adhesive on one face and release agent on the other to achieve preferential attachment. Need to consider the effect of compression set and load transmission.

Para 6. Process instructions: Process specification should give all details of surface treatments, primers, mixing and curing and any other information necessary to ensure a properly sealed joint.

Chapter 403 Castings

Not relevant to composite structure.

Chapter 404 Marking of Aeroplane Parts *Para 1. Introduction:* Chapter defines requirements for the marking of aeroplane parts so that they will be made easily identifiable. The design authority is responsible for selecting the types of marking and the method(s) of application. Contractor shall also apply such permanent and/or temporary markings as may be called for by the APD. *Para 2. Definitions:* Gives definitions for part, assembly, component, identification marking, permanent marking and temporary marking. *Para 3. General:* No marking shall reduce strength or increase corrosion. The number of markings shall be kept to a minimum. Details of markings are to be included in the drawings. *Para 4. Marking:* Gives requirements of markings on parts, assemblies, components, airframe components, oil tanks, fuel tanks, repairable parts and reconditioned parts. Typically include NATO stock number, manufacturers name and serial number. Some smaller parts are exempt from this. *Para 7. Location of identification markings:* Marking not to be placed; on bearing surfaces, on mating faces, on areas subsequently removed or obscured, near stress concentrations. *Para 8. Methods of identification marking:* Physical methods (metal stamping, engraving) not to be used where it could contribute to corrosion, loss of fatigue or static strength. Marking ink and labels to be compatible with the adhesives and paints it contacts. Electrochemical marking not to be used on defined metals and all non-metallic parts.
Leaflet 404/1 Methods for the identification marking of aeroplane parts *Para 1. Introduction:* Gives details of the methods recommended for identification marking. Tables provide guide for selection of marking methods for various categories of parts. *Para 2. Identification marking methods:* Gives brief description of the methods; metal die stamping, engraving, pack and label, embossed, paint and stencil, plastic label, metal and self-adhesive label, electrochemical marking.
Chapter 405 Exfoliation Corrosion of Aluminium Alloys Not relevant to composite structure.
Chapter 406 Stress Corrosion Cracking Not relevant to composite structure.
Chapter 407 Plastic Materials Not relevant to composite structure.
Chapter 408 Rubbers Not relevant to composite structure.
Chapter 409 Precautions against Corrosion and Deterioration *Para 1. Introduction:* Gives requirements for the protection of aeroplanes and their equipment against corrosion and environmental deterioration. *Para 2. Basic operational requirements:* Aim for all parts to be designed, protected, drained and vented so that, given Servicing Schedule maintenance, there is no unacceptable loss of airworthiness resulting from weathering, corrosion, abrasion or unavoidable mechanical damage to protective treatment. Must be able to withstand long term standing in the open, operation from salt-laden runways, flying low over the sea, for Naval planes the effects of salt spray and funnel gases. *Para 3. Exclusion of contaminating liquids:* All static joints are to be sealed. Take care to prevent water leaking into the aircraft on the ground or the air. Design aeroplane to minimise the possibility that any fluid, from leaks, condensation or spills, will cause corrosion. All compartments to be completely sealed or adequately drained. *Para 4. Access for examination:* Provide reasonable access to entire structure to allow inspection for corrosion and deterioration. Demonstrate compliance to CSDE or NATEC Project Team. *Para 7. Designation of the requirements for the protection of parts and assemblies:* Requirements for various materials given in paras below. The approved specification is to be included on the drawings for any parts/components that must be treated. *Para 21. Treatment of synthetic resin composites:* Internal surfaces may be left untreated. May paint to give desired colour. External surfaces shall normally be painted with an approved scheme preceded by an appropriate pre-treatment. Where surfaces of carbon fibre composites contact metals, special attention required to prevent galvanic corrosion. *Para 22. Treatment of radomes:* Use same considerations as for synthetic resin composites. Note that some materials may affect radar transparency. *Para 24. Precautions and treatments during assembly:* All static joints, except defined exceptions, to be wet assembled with an approved sealant. Ensure sealant completely fills joint. *Para 25. Treatment after assembly: touching up:* Surface treatments shall be repaired by the process originally applied, unless this will cause corrosion. Provides alternatives for some metals. *Para 26. Spare parts:* Preferably to be supplied in fully protected condition. Alternatively supply in primed condition and protected from oils. Gives treatments for some metals.
Leaflet 409/0 References Reference numbers and titles for reports into various aspects of corrosion on aircraft materials. Some RAE Technical Reports on environmental degradation of composites.

Leaflet 409/3 Avoidance of galvanic corrosion at bimetallic interfaces *Para 1. Introduction:* Leaflet gives advice on avoidance of corrosion due to galvanic action. Should be read in conjunction with BS PD6484, whose recommendations are based on service and laboratory experience. *Para 2. General:* Describes basic cause of galvanic corrosion. Materials divided into 4 classes depending on their effect on eachother. Table shows the corrosive effects of typical aircraft materials on eachother. *Para 3. Recommendations:* Table shows the class of materials that may be safely wet or dry assembled in particular environments.
Appendix 1 Detail Design and Strength of Materials, Military Derivatives of Civil Aeroplanes *Introduction:* Covers detail design and strength of materials requirements for military derivatives of civil aeroplanes. Describes differences between requirements of Def Stan 00-970 and other airworthiness requirements in terms of the additional requirements needed of civil aeroplanes if they are to be accepted for military applications. *Comments:* Some common areas with FAR 25 requirements. In general the military requirements are similar to the civil requirements. However in many cases the military requirements are somewhat more detailed. This generally requires a compliance check to check whether the civil aeroplane is satisfactory for military use.
Appendix No. 2 U.S. Military Specifications, Standards and Handbooks *Table:* Gives the Def Stan 00-970 Chapter and Leaflet titles, then the US specifications, standards or handbooks relevant to that section.
PART 5 AERO-ELASTICITY, NOISE AND VIBRATION
Chapter 500 Aero-Elasticity *Para 1. Introduction:* This Chapter is concerned with structural distortion and its effect on loads and stability, and the prevention of flutter. *Para 2. Effect of structural distortion on the loads on the aeroplane:* In all design calculations associated with Part 2 (loads), allowance shall be made for the flexibility of the structure. *Para 3. Effect of structural distortion on the stability and control of the aeroplane:* In design calculations associated with Part 6 (stability and control) and Chapter 729, allowance shall be made for the flexibility of the structure. *Para 4. Flutter:* The aeroplane shall be free from flutter or any other dynamic aeroelastic instability throughout the flight envelope. *Para 5. State of the aeroplane:* Requirements to be met for all authorised mass distributions and any stiffness changes that may be experienced throughout life. *Para 6. Effect of failures:* If any part of the structure is designed to be damage tolerant then these requirements are to be met with any damage up to the maximum permitted. *Para 7. Demonstration of compliance:* A programme of calculations and tests to demonstrate that the flutter requirement has been met shall be agreed with the APD. The interpretation of the results from the calculations and tests shall be agreed with the APD.
Leaflet 500/1 Flutter clearance programme *Para 1. Introduction:* Describes the programme of calculations and tests likely to be required to demonstrate compliance (Chapter 500, para 7). *Para 2. Flutter calculations:* Flutter calculations to begin early to assist in design layout. Select scope of calculations to reflect desired information. Assess sensitivity of flutter characteristics to changes in aerodynamic data. Determine effect of stability augmentation systems. *Para 3. Flutter margins:* Want to obtain parameter values in the flutter-free range. If flutter cannot be eliminated. Get flutter speeds greater than 1.15 V_D. *Para 4. Wind tunnel model tests:* Wind tunnel models are desirable to check aerodynamic assumptions. Can use direct or indirect checking. *Para 5. Structural tests on components:* Stiffness and/or still-air resonance tests on important structural components, especially those for which stiffness is difficult to estimate, are desirable. Advice given in Leaflet 500/6. *Para 6. Actuator impedance tests:* Impedance testing of control surface actuators required to check or provide data for flutter calculations. *Para 7. Still-air resonance tests:* Still-air resonance tests will be required. Aim to measure all undamped normal modes sufficiently well to use directly in flutter calculation. Repeat testing required after re-design. *Para 8. Initial flutter clearance:* Assuming preliminary testing is completed, first flights will usually be cleared to 0.5 V_D. Clearance to higher speed requires flight flutter testing. *Para 9. Flight flutter tests:* Instrumented aircraft is excited and the response analysed. Clearance to next increment will be given. Limited to 90 % of extrapolated speed where decay rate is 0. *Para 10. Final flutter clearance:* Normally given after flight testing to V_D. APD must agree on interpretation of test results. Need new program if there are substantial changes to the configuration.

Leaflet 500/2 Main surface flutter

Para 1. Introduction: Gives recommendations for the prevention of main surface flutter. Should be considered early in design phase. Simplest form arises from aerodynamic coupling of fundamental bending and torsion modes of a high speed aspect ratio wing. APD to be consulted for unconventional aeroplanes.

Para 2. Flutter calculations: Calculations play an essential part in the flutter clearance of high speed aeroplanes. Gives guidance and limitations on aspects of linear theory, which is used in small perturbation theory solutions, including degrees of freedom, mass distribution, damping and stiffness, and aerodynamic forces.

Para 3. Wing flutter: Metal wings designed to satisfy strength requirements generally meet the torsional stiffness requirements to prevent flutter. The relation between bending strength and torsional stiffness may no longer hold for composite wings. It is important to consider the effects of external stores, as these can significantly affect flutter speed.

Para 4. Tailplane flutter: Gives the different considerations for root-fixed tailplanes, all moving tailplanes or tailerons. In some cases need stiffening above that required for normal control.

Para 5. Fin flutter: Fins are generally handled in same way as the appropriate part of wing or tailplane flutter. T-tails may be powerfully destabilising and so needs extra care during design.

Leaflet 500/3 Flutter of control surfaces (ailerons, elevators and rudders)

Para 1. Introduction: Majority of flutter cases have involved motion of control surfaces. In some cases main surface motion also occurred, while in others the main surface motion was merely a response to the forcing of the control surface.

Para 2. Prevention of classical flutter: Principal methods (i) minimise inertia couplings between control rotation modes and distortion modes by adding appropriate mass to control surfaces, (ii) control system is stiff enough for natural frequencies of control-surface rotational modes that flutter speed is well above limit speed. Other methods used.

Para 3. Mass balance: Used if circuit stiffness is low. Detailed calculations required. Discussed variation in flutter speed with massbalance, margin of safety, effect of position of nodal line on amount of massbalance needed, distributed versus concentrated massbalance, effect of control circuit, effect of flexibility, attachment and other comments.

Para 4. Stiffness: If control surface operated by powered unit, ensure fundamental surface rotation frequency is above that of main surface modes. Discussed effect of massbalance flexibility, damping and impedance of control, and backlash.

Para 5. Dampers: Damping may suppress less severe flutter. Complete reliance on damping not recommended and must be agreed by APD.

Para 6. General comments on calculations: Discusses degrees of freedom to be included and prediction of aerodynamic forces.

Para 7. Static aeroelasticity: Data used in flutter calculations can also be used to estimate effect of flexibility on other cases. Uses, and discussed, the loss of rolling power as an example.

Para 8. Nature of buzz: Buzz of trailing edge control surface occurs at high subsonic speeds. Has limited amplitude so is not catastrophic. Describes the causes of buzz.

Para 9. Design considerations for buzz: Buzz is not predicted, but can be eliminated by making control surface natural frequency high or incorporating enough mechanical damping. Describes mechanical and aerodynamic fixes for buzz.

Leaflet 500/6 Stiffness tests

Para 1. Introduction: Usually compare test results to theoretical calculations. Can include effect of large loads. Gives comments on different types of tests, rather than detailed test requirements.

Para 2. Structures for stiffness testing: May be made on prototype aeroplane components or structural test specimens. Do large load effects as soon as suitable rigs become available.

Para 3. Tests on main structural components (wing, fuselage, fin, tailplane): Tests on prototype components allows comparison with theory and resonance testing (usually done around this time). Should evaluate joint between all moving surfaces and their operating jacks. Structural strength test specimens can resolve any remaining difficulties.

Para 4. Tests on control surfaces and flaps: Normally only necessary if calculations show stiffness is important. For powered surfaces need a test between surface, jack and mount.

Para 5. Wing pylons for stores or engines, and wing engine supports: Stiffness tests normally need to be done because of the difficulty in estimation. Results will be used to improve mathematical model of the structure. For pylons may test either pylon on a wing, or pylon in a rig.

Chapter 501 Requirements for Structural and Equipment Exposure to Noise and Vibration

Para 1. Introduction: Contains requirements aimed at ensuring that aeroplane structure and equipment functions and survives satisfactorily in the aeroplane noise and vibration environment.

Para 2. Requirements of the responsible agencies: Procurement agency must provide sufficient information in the form of design and approval severities or aeroplane operational environments. Different responsibilities depending on the form of the requirements.

Para 3. Noise and vibration requirements: Designer must demonstrate that all aspects of noise and vibration, on the airframe, equipment and humans, have been given proper consideration. No additional requirements are imposed provided that the design procedures adequately encompass noise and vibration aspects.

Para 4. Flight vibration survey: Flight vibration survey to be done to measure noise and vibrations. Requirements and guidelines given in Chapter 1016 and Leaflet 1016/1.

Leaflet 501/2 Sources of noise and vibration

Para 1. Introduction: Describes the sources of noise and vibration likely to be experienced. These are expanded in the paras below.

Para 2. Aerodynamic sources: Aerodynamic turbulence is most common and most severe where airflow detaches from structure. May be a problem with structure downstream of a vortex. Critical supersonic flow will cause intense local acoustic radiation. Wing buzz arises from coupling of shock wave and induced structural oscillations.

Para 3. Power plant sources: Engine intake flow can give strong acoustic resonances. Engine surge can give high strains in the intake structure. Mechanical sources usually not a problem.

Para 4. Jet plume effects: Jet mixing noise has produced fatigue cracking in many aircraft, but there are design rules to alleviate it. Shock cells in choked jets may pulse at the same frequency as structural panels. Jet attachment will produce significant increase in noise and vibration. Contact Director RAE Farnborough to get latest position.

Para 5. Cavities: Grazing flow past cavities causes significant noise and vibration. Frequencies can be readily calculated. Pressure fluctuations are more difficult.

Para 6. Operation of weapons systems: Gunfire is dealt with in Leaflet 501/4. Weapons release tends to be treated as a quasi-static loading condition.

Leaflet 501/3 Data analysis and assessment

Para 1. Introduction: Gives advice on the processing and assessment of measured flight data. This is done to determine vibration environment of aeroplane, to verify equipment is adequately designed, or to derive equipment test severities.

Para 2. Data processing: Normally start with a low fidelity time history as a quick look. Then do detailed examination of the most severe conditions from the quick look.

Para 3. Derivation of environmental descriptions: Summarises the in-flight vibrations experienced by the aeroplane. Need to choose the most appropriate format. Need to get a working knowledge of the effects of a variety of parameters on vibration severity.

Para 4. Derivation of test severities: General procedures given in DefStan 00-35. Testing to the worst condition is excessive, usually modify to allow for broader in-service perspective.

Annex A: There is an appendix on data gathering, with the headings of 1 general, 2 transducers, 3 signal conditioning, 4 recording of data, 5 analogue recording, 6 digital recording, 7 calibration, 8 record lengths, 9 data archiving.

Leaflet 501/4 The vibration effects of gunfire

Para 1. Introduction: Whilst the duration is short, the amplitudes of vibrations may be several orders of magnitude higher than those arising from normal flight. Leaflet gives advice and guidance on the vibration effects.

Para 2. Sources of excitation: Most significant is gun blast overpressure. Effects in near, middle and far spatial field are distinct. Also have recoil and ammunition/loading motions.

Para 3. Response severity: Near field excitations depend on character of the blast wave, particularly peak blast pressure. Gives two techniques to estimate the magnitude of this, but should supplement with measured data.

Para 4. Gunfire simulation: Use sequence of blast shock waves to simulate near field. For middle field superimpose series of in-phase sinusoidal vibrations on broadband random vibration. No need to include far field effects in any testing.

Para 5. Gunfire structural evaluation: Sufficient to show structure can withstand peak overpressure applied statically, fatigue considerations are unlikely to be significant.

Leaflet 501/5 The gunfire blast pressure field *Para 1. Introduction:* The distributed pressure load from the gun blast wave can produce significant shock and vibration loads on aeroplane structure and equipment. Leaflet describes the creation, characteristic and distribution of this pressure blast field. *Para 2. Description of the blast field:* Plots show effect of time and distance on pressure. Get a 400 to 700 mbar shock bottle 2 to 3, and Mach disc 10 to 16, calibres from muzzle. At any point get very rapid pressure rise, then a slower decay. Peak pressure falls with increasing distance from muzzle. *Para 3. Effects of aeroplane speed and altitude:* Aircraft movement throws blast wave backward. Plots show that increasing speed increases the distortion of the field. *Para 4. Effects of surfaces:* Surfaces introduce additional shocks, get regular and Mach reflections. Guns mounted on the sides produce more severe loading than in nose or wing. *Para 5. Effects of gun blast suppressors and deflectors:* Muzzle devices should be used to reduce blast pressure loads and deflect gases from the engines. Must be careful because this will raise pressure to side and rear. Information regarding design of suppressors may be obtained from The Director, RAE. *Annex A:* Annex presents a method for estimating the severity of the pressure blast field. It is a simplified version of the technique shown in references. Uses series of charts showing overpressure contours.
Leaflet 501/6 Propeller aeroplanes *Para 1. Introduction:* Provides information on the effects of the vibration environment arising from the action of propellers. Read in conjunction with Leaflet 501/2, 501/3, 108/4 and 108/5. *Para 2. Sources and mechanisms:* Propellers are the major source of vibration in this type of aeroplane. Spectra are the sum of many sources and mechanisms (mechanical imbalance, propeller blade modes, airflow interference, propeller pressure fields, vortices, and directivity effects), and so may be complicated to explain. *Para 3. Significant parameters:* The severity and character of vibration depend on the; aeroplane type, flight condition, position of the aeroplane, equipment mounting, equipment alignment and other parameters. *Para 4. Description of the environment:* Broadband random vibration spectrum superimposed strong forcing centred at frequencies associated with passing harmonics of the propeller. *Para 5. Simulation of the effects of the environment:* Simulation should recognise the basic characteristics described previously. Narrow band random is preferred to sinusoidal vibration. *Para 6. Human effects:* Not relevant to composite structures.
Appendix No. 1 Aero-Elasticity Requirements for Military Derivatives of Civil Aeroplanes. In general the entire contents of Chapter 500 will apply to military derivatives of civil aeroplanes. It will be necessary to conduct a detailed assessment of the aero-elastic calculations and computations against the military requirements of Chapter 500.
Appendix No. 2 U.S. Military Specifications, Standards and Handbooks *Table:* Gives the Def Stan 00-970 Chapter and Leaflet titles, then the US specifications, standards or handbooks relevant to that section.
PART 6 AERODYNAMICS, FLYING QUALITIES AND PERFORMANCE CONTENTS
Chapter 600 General Requirements and Definitions Not relevant to composite structure.
Chapter 601 Longitudinal Flying Qualities Not relevant to composite structure.
Chapter 602 Lateral and Directional Flying Qualities Not relevant to composite structure.
Chapter 603 Stalling, Post-Stall Gyrations and Spins and Miscellaneous Flying Qualities Not relevant to composite structure.
Chapter 604 Flight Control Systems Not relevant to composite structure.
Chapter 605 Handling Requirements for VSTOL Aeroplanes Not relevant to composite structure.
Chapter 606 Aeroplane Performance Criteria Not relevant to composite structure.
Chapter 607 Performance for Military Derivatives of Civil Aeroplanes Not relevant to composite structure.
Appendix No. 1 Aerodynamics and Flying Qualities for Military Derivatives of Civil Aeroplanes. Not relevant to composite structure.
Appendix No. 2 U.S. Military Specifications, Standards and Handbooks Not relevant to composite structure.

PART 7 INSTALLATIONS
Chapter 700 Propulsion System Installations Not relevant to composite structure.
Chapter 701 Refuelling and Defuelling Systems Not relevant to composite structure.
Chapter 702 Fuel Systems Not relevant to composite structure.
Chapter 703 Oil Systems Not relevant to composite structure.
Chapter 704 In-Flight Refuelling Systems Not relevant to composite structure.
Chapter 705 Pneumatic Systems Not relevant to composite structure.
Chapter 706 Hydraulic Systems Not relevant to composite structure.
Chapter 707 Electrical Installations Not relevant to composite structure.
Chapter 708 Radio and Radar Installations *Para 1. Introduction:* Installations shall have a proof factor of not less than 1.0 and an ultimate factor not less than 1.33. *Para 2. Aerial design:* Aerials shall be designed having due regard to electrical and mechanical performance. Mechanical requirements are to withstand aerodynamic loads, free from flutter, withstand vibration, birdstrike and environment. *Para 3. Aerial location on an airframe:* Aerial location shall give due consideration to electrical performance and mechanical constraints. The individual constraints are described. *Para 4. Aerial installation on an airframe:* Gives requirements for; resistance of electrical path, galvanic corrosion, wet assembly, sealant, tension, drainage, pressure sealing and retractable mountings. *Para 5. Radomes and aerials fairings:* The radome shall be structurally sound. It must be capable of withstanding aerodynamic loads and be resistant to erosion by rain, hail, and runway slush. With fairings at aeroplane extremities, lightning diverter strips (dc resistance ≤ 50 mΩ) are required. *Para 8. Static electrical charges:* Adequate means of dispersal of static electrical charges shall be provided. *Para 9. Testing:* Flight and ground testing to be in accordance with Aeroplane Specification or agreed with APD. *Para 10. Servicing:* Within technical constraints, the equipment shall be installed to meet the servicing requirements of Part 8.
Leaflet 708/0 Reference page Reference numbers and titles for reports into various aspects of radio and radar installations.
Chapter 709 Bonding and Screening *Para 1. General:* Screening is done to prevent radiation of radio-interference from and to electrical equipment and associated wiring. Bonding is done to reduce the risk of fire due to lightning discharges and the accumulation of electrostatic charges, and to increase the efficiency of the radio installation. *Para 2. Screening and interference suppression:* All circuits that induce r.f. disturbances shall be enclosed by a screen, which shall be bonded to the ground at two or more points. *Para 3. Bonding:* All metallic parts to be connected to form an electrically continuous system of low and constant impedance. Need to account for the electrical properties of composites and the ability to make satisfactory connections. Need to consult with APD on acceptable resistances. Gives requirements for A, C, H, R and S class bonding. *Para 4. Lightning strike protection:* Due consideration shall be given to the effects of lightning strike. Need a lightning study. Gives requirements for primary conductors. Bonding as per para 3 is usually sufficient. Consider strike plates and bonding straps for composites. Ensure all parts are electrically bonded to the structure. When the Study of Lightning Protection recommends lightning tests, these shall be done in accordance with Leaflet 709/3, except where agreed with the APD.
Leaflet 709/0 Reference page Reports regarding bonding and screening.
Leaflet 709/1 Screening – general recommendations Continuity of screening should be maintained by the use of approved cable glands and metal enclosures for junction terminals and equipment.
Leaflet 709/2 Bonding of control surfaces *Para 1:* Electric current cause pitting in ball joints or roller bearings. Use flexible bonding leads to carry currents. *Para 2:* Electrostatic discharges also cause pitting but are not fatal. Not necessary to use jumpers for this. *Para 3:* Lightning discharge currents cause sufficient pitting to temporarily lock bearings. Insignificant torque required to restore motion.

Para 4: Use of bonding jumpers is therefore not a requirement. *Para 5:* Recommended that control surface bearings be examined for pitting subsequent to any lightning strike.
Leaflet 709/3 Recommended lightning tests *Para 1. Electrical parameters of lightning:* Earth flash is the most damaging type of lightning so simulated tests are based on this type. Entry and exit points are difficult to distinguish so just call them both attachment points. Important parameters are peak current, rate of rise, total duration, charge transferred and the action integral. *Para 2. Grouping of tests according to effects produced:* Conduct tests according to the effects. Group 1 is due to peak current, charge and action integral. These cause burning, eroding, structural deformation, shock waves and magnetic forces. Group 2 is due to induced voltages from the flow of current. This causes induced voltages, voltage flash over, sparking and fuel ignition. *Para 3. Division of aeroplane in to zones according to lightning attachment characteristics:* Aircraft are divided into zones according to the lightning attachment characteristics. Zone 1 surface with high probability of initial flash attachment, Zone 2 surfaces of vehicle with high probability of flash being swept from Zone 1, Zone 3 is remaining surface. Zone 1 and 2 divided into A and B regions. A has low probability the arc will remain attached, B has high probability. *Para 4. Application of current test waveforms:* Swept strokes occur because the lightning channel remains stationary while the plane moves through it. Must select the most appropriate waveform and dwell time of the sweep stroke when setting up for testing. *Para 5. References:* Publications on simulated lightning tests.
Chapter 710 Gun Installations Not relevant to composite structure.
Chapter 711 Armament Installations *Para 1. Introduction:* Chapter states design requirements for the installation of armament equipment - weapons installations, equipment and circuits concerned with monitoring, control and release or firing of stores. All weapons systems to be approved by D.A. Arm MOD(PE) or appropriate approving authority. *Para 3. Strength and environmental conditions:* The installation for armaments shall satisfy the strength and stiffness requirements for aeroplanes as a whole. This must occur for all carriage, operation, release and jettison conditions. Armament shall operate satisfactorily under environmental conditions quoted in Chapter 101. *Para 15. Operation of weapon bay doors:* Doors need positive means of operating. Design so that door operation not prejudiced by aeroplane deformation, alignment or environment. Doors to operate within six seconds. *Para 20. General safety and reliability:* Chapter has assumed that two failures during transit are unlikely, and structural failure of components can be eliminated by design and procedure. Can thus ensure no single failure will prevent, nor cause inadvertent, weapons release.
Chapter 712 Ice Protection *Para 2. Operational requirements:* Aeroplane to be capable of operating, landing and take-off in defined conditions (icing, snow, fog, rain etc). No degradation in performance of aeroplane or weapons systems and handling qualities. *Para 5. Ice protection coverage:* Gives list of parts to consider protecting from ice. Need to consider worst conditions when determining extent of protection. Also need to consider effects on unprotected areas when ice is shed. *Para 8. Design and construction:* Protection system to conform to BS 3G 100. System to conform to strength and fatigue requirements. Materials must not be adversely be affected by protection. Use temperature limiting devices if necessary. System needs to be reliable, available, maintainable and testable. *Para 9. Testing:* Demonstrate compliance by ground or flight test, in accordance with Chapter 1006.
Leaflet 712/0 Reference page Reports regarding icing protection.

Chapter 713 Fire Precautions

Para 1. Introduction: All aeroplanes must meet the requirements defined in this Chapter. Definitions essential for correct interpretation are given in Leaflet 713/1.

Para 2. General requirements: Fire zones to be designated. Perform survey to determine fire risks. Prevent flammable fluids entering designated fire zones. Use fireproof/resistant materials through designated fire zones. Ensure adequate fire fighting equipment in designated zones.

Para 3. Precautions in designated fire zones: Designated zones are around engines, auxiliary power units and combustion heaters. Protect these from effects of torching flames. Flammable fluid systems to be fire resistant. Drains, vents and ventilation to be provided. Flammable fluid shut-off shall be provided for. Firewalls to isolate each flammable zone. Defined fire detection, warning and extinction systems required. Compliance shall be shown by full-scale test unless specified otherwise.

Para 4. Precautions in other zones: Flammable fluid fire protection done by minimising probability of ignition, demonstrate by analysis or test. Areas adjacent to designated fire zones and engine nacelle attaching structures shall meet requirements of flammable fluid systems and drains, vents and ventilation. Also must survive if inside of firewall exposed to 1100 °C for 15 min.

Para 6. Electrical system and smoke protection: Must be able to withstand 1150°C for 15 min on adjacent firewall. Equipment failure must not result in noxious products distributed to crew. Design equipment that may contact flammable vapours to BS3G100, Part 2, Sect 3, Sub-sect 3.5.

Para 8. Cargo Bays: Defines class A to E cargo bays, in terms of accessibility and ease of fire detection. Do not allow critical systems to pass through cargo bays. Insulate any heat sources that are within compartments. Gives requirements for fire detection equipment, if required.

Para 11. Precautions: combat induced fires: Components to be designed to minimise risk of ignition due to battle damage. Requirements given for fire detection and suppression systems in dry bay areas adjacent to fuel tanks and for fuel system inerting.

Para 12. Compartment interiors – test criteria: Materials in defined locations eg. interior ceilings, floor coverings, windows, must comply with requirements of the test described in Leaflet 713/4 (JAR 25.853 Appendix F) or equivalent. Different test results required for different locations and types of material.

Leaflet 713/0 Reference page

Gives relevant report number and title from MoD, RAE, British Standards, MIL Standards, USAF, FAA, JAA, SAE, British CAA and AGARD related to fire precautions.

Leaflet 713/1 Definitions

Para 1. Introduction: Gives the definitions of terms used in Chapter 713 and related Leaflets.

Para 2. Definitions: Most important definitions are: Designated fire zone, where a single failure could result in a fire or the breakout of an existing fire. Fireproof, components are capable of withstanding the standard flame for 15 min. Can withstand flame at least as well as steel. Fire resistant components are capable of withstanding the standard flame for 5 min. Can withstand flame at least as well as aluminium. Standard flame burner gives a nominal flame temperature of 1100 °C and characteristics given in ISO/TR 2685.

Leaflet 713/2 General recommendations

Para 1. Introduction: Gives acceptable methods of meeting certain of the basic requirements of Chapter 713.

Para 2. Designated fire zone isolation: Firewalls, and air ducts through them, should be made of stainless or titanium >0.4 mm thick. Design wall to avoid distortion and limit explosions.

Para 3. Flammable fluid tanks: Locate so they will not be damaged by uncontained engine failure or collapsing undercarriage. See Chapter 709 for lightning protection.

Para 4. Fire extinguishing system: Demonstration of effectiveness to be agreed with APD. Recommend using BCF or BTM. Gives requirements for extinguishant quantities, and a method for calculating this amount. Design pressure relief valves for extinguishers not to discharge before system has operated. Give visual indicator for maintenance personnel.

Para 5. Fire detection system: Should only respond to a genuine fire. Must operate quickly and indicate when fire is out. Must be designed so a fire does not incapacitate them.

Para 6. Drains and vents: Avoid manifolding where possible. Locate to avoid adverse differential pressures. Consideration to be given to eliminating blockages from ice or snow.

Para 7. Class D cargo compartments: ventilations: Defines maximum ventilation rate for compartment. Need full-scale test to demonstrate fires are contained in >28 m^3 compartments.

Para 8. Access panels: Panels for engine and APU are to be positioned so that standard Services fire fighting nozzles will allow extinguishant to reach the fuel system and combustion area. Each panel to be approximately 100 mm square and easily opened by with a sharp blow.

Para 9. APU emergency stop: An emergency stop is recommended if the APU can be run without ground crew attendance.

Leaflet 713/3 Combat induced fires *Para 1. Introduction:* Leaflet amplifies the requirements relating to combat induced fire precautions in Chapter 713 para 11. *Para 2. Combat induced fire hazards:* Important to assess the risk of ignition of fuel. Primary fire is directly caused by projectile impact, while secondary fire is due to fuel leaking onto ignition sources. Gives the mechanism of ignition in metal structures for both inert fragments and incendiary projectiles. Composites modify this mechanism because no incandescent metal particles are formed, but metallic fasteners means the overall effect is similar. Crew is vulnerable to 5-10 cal cm^{-2}, which nuclear weapons may give. *Para 3. Precautions: combat induced fires:* Special consideration to be given to threat induced fire protection in non-designated fire zones. Focus on optimum positioning and shielding of flammable fluid systems and components. Equipment relocation may reduce the need for fire precaution due to projectile strike. *Para 4. Fire detection:* Gives recommendations for optical systems in dry bays. Optimum time to extinguish combat fires is 1-5 ms after ignition. Existing UV and IR systems can do this. *Para 5. Fire and explosion suppression:* Gives the considerations when using explosion suppressant foam (protect equipment, ensure void is filled) or active fuel tank explosion suppression (ensure oxygen content < 9%, benign inerting gas, limited overpressure allowed).
Leaflet 713/4 An acceptable test procedure for showing compliance with Chapter 713 paras 12 and 13 *Para 1. Conditioning:* When determining fire resistance of materials specimens must be conditioned at 21±5 °C, 50±5 %RH until equilibrium, or at least 24h. *Para 2. Specimen configuration:* Defines the size, source, thickness, and test direction for fabrics of materials for fire tests. *Para 3. Apparatus:* Use draught free cabinet. Federal Test Method Standard 191 Method 5903 for vertical test and Method 5906 for others. *Para 4. Vertical test, in compliance with Chapter 713, paras 12.2 and 12.3:* 843°C Bunsen or Tirrill burner flame along bottom centreline of vertically mounted specimens. Apply flame for 60 or 12 sec. Measure burn time, length and flaming time drippings. Test a minimum of three specimens. *Para 5. Horizontal test, in compliance with Chapter 713, paras 12.4 and 12.5):* Same flame. Horizontal specimen. Apply flame for 15 s. Record burn rate. *Para 6. 45° Test, in compliance with Chapter 713, para 13.1:* Same flame. Apply flame for 30 s. Record flame time, glow time, and whether flame penetrates. *Para 7. Burn length:* Distance from original edge to farthest evidence of flame induced damage.
Chapter 714 Installation for Emergency Recovery from Stall and Spin Not relevant to composite structure.
Chapter 715 Magnetic Compass Installations Not relevant to composite structure.
Chapter 716 Pressure Cabins *Para 1. Introduction:* Requirements apply to all pressurised cockpits or cabins. *Para 2. Differential pressure requirements:* Aeroplane will be specified with either (i) low differential pressure system. For short duration aeroplanes with crew in fixed positions and routinely using oxygen, or (ii) high differential pressure system. Long duration, multi-seat, aeroplanes where crew are free to move and oxygen not routinely used. *Para 10. Test connections:* *Para 11. Strength of pressure cabin:* Two pressures are considered (i) maximum working differential pressure DP_W that is setting of discharge valve, (ii) relief differential pressure DP_R maximum pressure if valve is blocked. Require proof and ultimate factors of at least 1.125 and 1.5 for defined positive and negative internal pressure loads. *Para 12. Fatigue life:* Fatigue analysis, under spectrum agreed by APD (&AD, RAE), of pressure cabin and local structure required. Must include flight and inertial loads. Must show safe life exceeds specified life using Leaflet 201/1 or other agreed criteria. *Para 13. Static strength of pressurisation system:* All components, pipes and ducting shall have proof and ultimate factors of 1.125 and 1.5 for defined differential pressures in the cabin. *Para 14. Strength tests:* Proving test (Leaflet 716/1) to 1.125 times max differential pressure to be done in each cabin after installation. Strength calculations shall be supported by static pressure tests (Leaflet 716/1). A fatigue test will be conducted on a representative pressure cabin unless the pressurisation loads can be shown to be insignificant.

Leaflet 716/1 Strength testing *Para 1. Introduction:* Leaflet amplifies the strength test requirements of Chapter 716 and makes recommendations on test methods. *Para 2. Loading conditions:* Chapter 716 para 13.2 call for tests under conditions in para 11.2 or 11.3. Loading cases and methods of testing should be discussed and agreed with the APD. *Para 3. Method of test:* The best technique is to use water as the pressurising medium. Place structure in a tank, fill cabin and tank, and apply pressure internally. Should be possible to detect weaknesses, repair the structure, and then continue to higher pressures. *Para 4. Dangers and disadvantages of using air pressure:* Sudden energy release upon failure may produce widespread damage. This is very dangerous to personnel and surrounding equipment. The structure is usually heavily damaged and cannot be repaired for further testing. *Para 5. Proving tests using air pressure:* Functioning, leakage and proving tests must be done with air. Appropriate precautions when using air as the loading medium are described. *Para 6. Routine tests in service:* In routine tests it is not normal to exceed the maximum differential pressure for normal operation.
Chapter 717 Emergency Liferaft Installations Not relevant to composite structure.
Chapter 718 Oxygen Installations Not relevant to composite structure.
Chapter 719 Transport Aeroplanes - Role Equipment: Installations Not relevant to composite structure.
Chapter 720 Optical Transparent Components - Design, Installation and Testing Not relevant to composite structure.
Chapter 721 Optical Transparent Components - Requirements for Satisfactory Vision Not relevant to composite structure.
Chapter 722 Static and Pitot Pressure Systems Not relevant to composite structure.
Chapter 723 Protection from the Effects of Nuclear Explosions, Laser Weapons, Chemical and Biological Warfare Agents *Para 1. Introduction:* Chapter specifies the design requirements that will enable aeroplanes to survive the NBC and/or laser environments. Where there is a requirement for NBC and/or laser hardening, this Chapter gives the requirements. Some of the reference documents are classified and available only on a need-to-know basis. *Para* 2. General requirements: *Para 3. Nuclear environment requirements:* Aim is to survive the environment given in Def Stan 08-4 Part 4/2 Chapter 4-40 Table 1. Designer needs to perform a Nuclear Survivability Feasibility Study. If estimated hardness levels are not acceptable to APD, it may be necessary to redefine the environment criteria. *Para* 4. Chemical and biological environment requirements: *Para* 5. Laser requirements:
Leaflet 723/0 Reference page References on the effects of NBC weapons.
Leaflet 723/1 Definitions List of definitions.
Leaflet 723/2 Nuclear weapon effects on aeroplanes *Para 1. Introduction:* Leaflet gives information on the effects of a nuclear explosion on aeroplanes, methods to evaluate hardness, and guidance on how to improve hardness. *Para 2. Nuclear weapons effects on aeroplanes:* Gust effects, if sufficiently large, may lead to structural deformation. Overpressure produces high reflected pressure, short duration pulse, which affects smaller structures such as the skin, stringers and frames. Thermal radiation effects are greatly influenced by atmospheric conditions and aeroplane motion. Thin skinned composite may delaminate due to high thermal gradient. *Para 3. Nuclear hardness evaluation of airframe and equipment:* Techniques given to calculate effects of gusts, overpressure, thermal radiation, initial radiation and electromagnetic pulse.
Chapter 724 Air Launched Weapons Installations Not relevant to composite structure.
Chapter 725 Brake Parachute Installations Not relevant to composite structure.
Chapter 726 Reconnaissance and Survey Camera Installations Not relevant to composite structure.
Chapter 727 Aircrew Equipment Assemblies Not relevant to composite structure.
Chapter 728 Installation of Explosive Devices Not relevant to composite structure.

Chapter 729 Design and Performance of Autopilot and Flight Director Installations Not relevant to composite structure.
Chapter 730 Arresting Hook for Land-Based Aeroplanes Not relevant to composite structure.
Chapter 731 Pressurised Gas Storage Vessels Not relevant to composite structure.
Chapter 732 Fatigue Load Meter Installations Not relevant to composite structure.
Chapter 733 Lightning Strike Protection Not written.
Chapter 734 Target Towing Installations Not relevant to composite structure.
Chapter 735 Instrument/Display Installations Not relevant to composite structure.
Chapter 736 Avionics Equipment Installations Not relevant to composite structure.
Chapter 737 Conditioning Systems Not relevant to composite structure.
Chapter 738 Software Not relevant to composite structure.
Chapter 739 Safety Critical Software Not relevant to composite structure.
Chapter 740 Strength of Pressurised Air Ducts and Pipes Not relevant to composite structure.
Chapter 741 Health and Usage Monitoring Systems Not relevant to composite structure.
Appendix No. 1 Installations for Military Derivatives of Civil Aeroplanes Not relevant to composite structure.
Appendix No. 2 U.S. Military Specifications, Standards and Handbooks Not relevant to composite structure.
PART 8 MAINTENANCE
Chapter 800 General Maintenance Requirements *Para 1. Introduction:* Airplane shall be designed to minimise the need for servicing or inspection. When required they should be as easy as possible (standard tools, minimum manhours). *Para 2. Designing for maintenance:* During design special attention to be given to easing maintenance and reducing; complexity, service frequency, maintenance downtime, support costs and possibility of maintenance error. *Para 3. Handling:* Requirements are given in Chapter 801. Use standard equipment wherever possible. *Para 4. Routine service and repair:* Requirements given in Chapter 802. Give consideration to reducing repair work arising from normal operating hazards (birdstrike, heavy landing). *Para 5. Replacement and interchangeability (also Chapters 804 and 805):* Requirements are to make details accessible, interchangeable, and require a minimum of special equipment. *Para 6. Accessibility:* Allow access to parts and structure for the purpose of inspection, replacement, adjustment and lubrication wherever practical. Used hinged panels where practical. *Para 8. Condition inspection equipment:* Consider the incorporation of condition monitors to more accurately assess the life of components.
Chapter 801 Transport, Handling and Storage *Para 1. Transport of components:* Components should be able to be packed for transport. Should be able to subdivide aeroplane into components of defined size and weight, suitable for transport. Wherever possible normal cases are to be used. Wings and tail to be stored vertically or flat, not diagonally. *Para 2. Ground handling:* Aeroplane should be designed to use standard equipment and tools and ground support equipment (GSE) for servicing. Need to consider operation by personnel in NBC protective clothing, reliability and ease of use when special to type GSE is required. *Para 3. Jacking:* It shall be possible to raise the aeroplane at three primary jacking points. Jacked aeroplane must be stable. Use standard jacks and, if required, jack pads. *Para 4. Slinging:* Aircraft below 20412 kg must be able to be lifted by slings. Components too heavy for manhandling shall be able to be slung. *Para 5. Ground towing:* Provision shall be made for towing by a standard towing vehicle. Towing points and load limitations are defined.
Leaflet 801/0 Reference page References on transport, handling and storage.

Chapter 802 Routine Servicing *Para 1. General:* Design shall cater for servicing (flight servicing, draining and replenishment of consumables, re-arming, check and replacement of avionics) in defined conditions (temp, wind, clothing, rolling decks, tools) that are not those of a well lighted and heated workshop. Turn around time shall satisfy staff requirements. *Para 2. Inspection:* Parts requiring frequent inspection and replacement shall be easily accessible. *Para 3. Lubrication:* Not relevant to composite structure.
Leaflet 802/0 Reference page References on routine servicing.
Chapter 803 Repairs *Para 1. General:* Consideration to be given to easing repair in service. Repairs to be done by service personnel. Special techniques not acceptable if repair of minor damage is precluded. *Para 2. Strength:* Repairs must comply with overall aeroplane requirements. Reserve on unrepaired member to be >1.2. Ensure multiple repairs to not degrade strength excessively. If this is not possible the matter shall be referred to the Director, RAE. *Para 3. Material:* Standard materials and methods of repairs to be used wherever possible. *Para 4. Composite materials:* Likely that 2nd to 4th line will perform composite repairs. Patches are to be flush and comply with relevant design requirement. Must consider environment, screening, NDT, galvanic corrosion, inspection, replacement, degradation from fluids, fretting, lightning strike and EMC protection.
Chapter 804 Replacement of Components *Para 1. Dismantling and erection:* Components shall be constructed to permit rapid dismantling and erection by service units. Components liable to damage shall be easily replaced. When it is necessary to break components for replacement, the attachment fittings shall facilitate this (quick release mechanism or minimum number of bolts).
Chapter 805 Interchangeability *Para 1. Introduction:* Chapter gives interchangeability requirements for production aeroplanes and accessories. Provision for complete interchangeability to receive full consideration in design of aeroplane. See also Def Stan 05-123, Chapter 201. *Para 2. Basic requirement:* All items to be designed and manufactured to allow replacement with a stock item, without degrading their functional capability. Procedure for exemption in Def Stan 05-123, Chapter 201, para 8. *Para 3. Definitions:* Fully interchangeable can be installed without alteration. Replaceable items may need some features altered (trimming, drilling) to facilitate installation. *Para 4. Limits:* Limits of all dimensions that affect assembly or functionality shall be clearly stated on the drawings. *Para 5. Jigs, templates and gauges:* Contractor shall provide all jigs, templates and gauges necessary to meet interchangeability requirements. *Para 6. Dimensioning of drawings:* Dimensions shall be given from a chosen datum, preferably on the part to assist inspection. Use a rectangular coordinate system. *Para 7. Data sheets:* Interchangeability data sheets, showing clearances and tolerances, to be made for each new aeroplane. Details of shims or bushes used at rigid attachments to be given. *Para 8. Attachment of main components:* Provision to be made (shims and bushes) to ensure main components do not have to be altered during fitting. *Para 9. Hinges:* In an arrangement of hinges, one is to be the datum hinge from which all others are dimensioned. Sufficient clearance must be provided for male and female sections. There must be no danger of fouling other parts of the structure. *Para 10. Piano hinges:* Piano hinges are not to be separated, but installed as one part. Datum points to be specified. *Para 11. Cowlings and panels:* Any method authorised by the MoD Quality Assurance Authority may be used to obtain interchangeability of cowlings, panels, etc. *Para 12. Aerodynamic characteristics:* Take care to minimise variation in part contour when this influences aeroplane performance. Use appropriate jigging for critical positioning.
Leaflet 805/0 Reference page References on interchangeability.
Chapter 806 Markings and Notices *Para 1. Introduction:* Chapter gives requirements for markings and notices necessary to facilitate servicing. Wherever possible adhesive markings shall be used. *Para 3. Rigging and cg datum marks:* All aeroplanes to have longitudinal and lateral rigging positions marked. Datum and cg points to be permanently marked in an accessible location. *Para 4. Servicing points:* To be marked in accordance with Def Stan 05-18. Additional limits for fuelling pressures to be shown as well. *Para 10. Strong points:* Strong points for ground handling are to be marked in accordance with Def Stan 05-18. *Para 11. Walkways:* Boundaries of walkways and no-stand areas are to be marked in accordance with Def Stan 05-18.
Leaflet 806/0 Reference page Gives titles and report numbers of specifications and standards related to markings and notices.

Appendix No 1 Military Derivatives of Civil Aeroplanes *Para 3. General maintenance requirements:* Military requirements are more specific than civil requirements, but civil policies generally applicable. Need to compare civil procedure with appropriate military requirements. *Para 4. Transport Handling and Storage:* No equivalent civil requirements, however policies for military aeroplanes would be generally applicable. Need to compare civil procedure with appropriate military requirements. *Para 5. Routine Servicing:* No equivalent civil requirements, however policies for military aeroplanes would be generally applicable. Need to compare civil procedure with appropriate military requirements. *Para 6. Repairs:* No equivalent civil requirements, however policies for military aeroplanes would be generally applicable. Need to compare civil procedure with appropriate military requirements. *Para 7. Replacement of Components:* No equivalent civil requirements, however policies for military aeroplanes would be generally applicable. Need to compare civil procedure with appropriate military requirements. *Para 8. Interchangeability:* No equivalent civil requirements, however policies for military aeroplanes would be generally applicable. Need to compare civil procedure with appropriate military requirements. *Para 9. Marking and Notices:* Military requirements are more specific than civil requirements, but civil policies generally applicable. Need to compare civil procedure with appropriate military requirements.
Appendix No. 2 U.S. Military Specifications, Standards and Handbooks Potentially some useful references for precaution against corrosion and deterioration (Chapter 801), routine servicing (Chapter 803), repairs (Chapter 804).
PART 9 FLIGHT TESTS - HANDLING
Chapter 900 General Handling Flight Test Requirements Not relevant to composite structure.
Chapter 901 Ground Handling Not relevant to composite structure.
Chapter 902 Take-off and Initial Climb Not relevant to composite structure.
Chapter 903 Circuit, Approach, Landing and Overshoot Not relevant to composite structure.
Chapter 904 Longitudinal Trim, Stability and Control Not relevant to composite structure.
Chapter 905 Demonstration of Limits of Flight and Manoeuvre Envelopes Not relevant to composite structure.
Chapter 906 Lateral and Directional Trim, Stability and Control Not relevant to composite structure.
Chapter 907 Rapid Rolling/Roll Coupling Not relevant to composite structure.
Chapter 908 Behaviour at or Near the Stall Not relevant to composite structure.
Chapter 909 Lift Boundaries Not relevant to composite structure.
Chapter 910 Spinning Not relevant to composite structure.
Chapter 911 Aerobatic Manoeuvres Not relevant to composite structure.
Chapter 912 Effect of Engine Failures Not relevant to composite structure.
Chapter 913 Effect of System Failures Not relevant to composite structure.
Chapter 914 Automatic Flight Control Systems and Flight Directors Not relevant to composite structure.
Chapter 915 General Handling Not relevant to composite structure.
Chapter 916 Air-To-Air Refuelling Not relevant to composite structure.
Chapter 917 Handling Tests Specific to VSTOL Aeroplanes Not relevant to composite structure.
Chapter 918 Handling and Performance in Icing Conditions Not relevant to composite structure.
Appendix No 1 Not Used
Appendix No. 2 U.S. Military Specifications, Standards and Handbooks

PART 10 FLIGHT TESTS - INSTALLATIONS AND STRUCTURES
Chapter 1000 General Flight Test Requirements - Systems and Structures *Para 1. Introduction:* States the tests that are required to be made to demonstrate compliance with Part 7. *Para 2. Relevant design requirements:* Each Chapter of this part repeats the design requirements associated with the flight tests of that Chapter. This is for information only. The full requirements must be consulted for design purposes. *Para 3. Applicability:* Tests apply to all new types of aeroplanes and aeroplanes where modifications are likely top affect the results of the test. Tests will be conducted on systems that are to the final Service standard. *Para 5. Loading:* Unless specified, the tests may be conducted at any convenient aeroplane loading or centre of gravity. *Para 6. General Test Conditions (see also Chapter 900):* Conditions are specified in each Chapter. *Para 7. Tests:* Contractor is primarily responsible for flight tests, which must be conducted to the satisfaction of the APD. Air-to-air refuelling significantly increases fatigue usage. This must be considered.
Chapter 1001 Engines Not relevant to composite structure.
Chapter 1002 Auxiliary Power Sources Not relevant to composite structure.
Chapter 1003 Electrical Systems Not relevant to composite structure.
Chapter 1004 Hydraulic Systems Not relevant to composite structure.
Chapter 1005 Fuel Systems Not relevant to composite structure.
Chapter 1006 Ice Protection Systems Not relevant to composite structure.
Chapter 1007 Conditioning Systems Not relevant to composite structure.
Chapter 1008 Alighting Gears Not relevant to composite structure.
Chapter 1009 Arrestor System Not relevant to composite structure.
Chapter 1010 Powered Flying Controls Not relevant to composite structure.
Chapter 1011 Electromagnetic Compatibility of Safety Critical Systems *Para 1. Object:* The object of these tests are to demonstrate that electronic/electrical systems, which are safety critical, operate satisfactorily in the electromagnetic environment both generated by the aeroplane, and that corresponding to the operational requirement. *Para 2. Relevant design requirements:* Document to be written defining the limits of satisfactory operation, criteria against which this shall be judged, methods of monitoring and limits of responsibility of Contractor and Project Office. Defined the chain of command for the acceptance of the document. *Para 3. Applicability:* Tests are applicable to all new electronic/electrical safety critical systems and all systems where modifications are likely to affect the test results. Critical systems are those in which a disturbance could result a direct hazard to the aeroplane, aircrew, people or property on the ground. *Para 4. Equipment:* Basic equipment required are; source of EM field, antennae to measure field strength, probe to measure interference, instrumentation to indicate system performance. *Para 5. Ground test conditions and requirements:* Need sound information regarding likely EMC characteristics as a precursor to testing. *Para 6. Test details:* Each system to be tested shall be exercised through its susceptible modes while other systems are brought into operation. Subsequently the systems are to be operated while the aeroplane is illuminated from a source. Induced interference is to be continuously monitored. Margins of safety are to be determined in systems that do not fail.
Chapter 1012 Not used Not relevant to composite structure.

Chapter 1013 Water Proofing *Para 1. Object:* To ensure satisfactory watertightness of cabin and other defined parts of the aeroplane. Also to ensure satisfactory drainage ability of internal bays and compartments where water may collect. *Para 2. Relevant design requirement:* DEF STAN 00-970 Volume 1 Chapter 409. *Para 3. Applicability:* Ground and flight tests to be made in full on development and first of any production aeroplanes that embody alterations likely to affect watertightness. *Para 4. Ground tests:* Test to be done after cabin pressure proving test. Close all opening/closing parts. Spray for 20 minutes from different angles. Thoroughly inspect for leaks and accumulation. Open access points and inspect. *Para 5. Flight tests:* Do flight test after ground test. Stand in, take off, and fly in rain approaching maximum expected intensity. Operate equipment that can be retracted and extended. Inspect all accessible compartments for leaks.
Chapter 1014 Armament Installations Not relevant to composite structure.
Chapter 1015 Structures *Para 1. Introduction:* The Chapter states requirements for load and temperature measurement during manoeuvres and the demonstration of structural strength. *Para 2. Basic requirements:* Scope of load measurement plan is to be agreed with APD (&AD RAE). Flight tests should be coordinated with the static and fatigue strength tests. *Para 3. Applicability:* Should be done on an early development aeroplane. Further tests conducted on later development aeroplanes if necessary. *Para 4. Test requirements:* Consider the following load cases; symmetric manoeuvres, asymmetric manoeuvres, gusts, turbulence, special manoeuvres, take-off and landing. Determine magnitude, distribution and time history of these cases. Structural strength to be demonstrated at design limit conditions. Inspect after the tests. No sign of proof failure. *Para 5. Measurements:* Sufficient load, temperature, aero-elastic, vibration and flight parameter data are to be gathered to establish loading with reasonable accuracy. *Para 6. Flight limitations and the relation between static strength tests and flight tests:* Phase tests with static strength tests so that flight loads can be used in static tests. Initial flight tests to be limited to 80 % of unfactored design loads.
Leaflet 1015/1 General information *Para 1. Introduction:* Leaflet amplifies the requirements of Chapter 1015. *Para 2. Basic aim:* Flight tests, in conjunction with the static and fatigue strength tests, are done to ensure the structure achieves the required strength factors under actual loading. Flight testing also provides information on the loads to be applied in the fatigue test. *Para 3. Relation with static strength tests:* Flying is restricted to Leaflet 200/5 levels until static strength tests have confirmed a satisfactory strength level. Data from the restricted flight tests may be used to (i) reassess the result from early strength tests and (ii) provide realistic loads for subsequent static tests. An ideal procedure is given below. *Para 4. Procedure:* Phase flight and static tests. Use static test procedure in Leaflet 200/2. Use two-way information flow to refine subsequent loading. Take appropriate precautions if design loads are reached prematurely. *Para 5. Relation with fatigue tests:* Loads from flight tests provide valuable data for fatigue test. Application frequency must be obtained from Service records. Reliance on calculated loads may produce large errors. *Para 6. Methods of load measurement:* Use strain gauging and/or pressure plotting.
Chapter 1016 Flutter and Vibration *Para 1. Introduction:* Chapter regards requirements to confirm and explore the flutter characteristics (to demonstrate aeroplane is flutter free over the specified envelope) and obtain vibration measurements (to assess the suitability of equipment design and test severities). *Para 2. Requirements:* Flight flutter test to be undertaken before high speed flight. Measure response to applied excitation, at increasing speeds, over the appropriate range of flight conditions. Then do flight vibration study throughout the operational flight envelope. Measure at sufficient locations to determine overall aeroplane vibration severities.
Leaflet 1016/1 Flight vibration study *Para 1. Introduction:* Testing undertaken to establish vibration severities at various locations during specific flight conditions. Assists in identification of flight conditions producing significant vibrations. Survey establishes general vibration severities in aeroplane, rather than vibration in specific equipment. *Para 2. Measurement requirements:* Recommendations on the type, quantity and location of measurements. Typically require 50 or more measurements. Usually us accelerometers. Location depends on structure but should be; even over structure, attached to rigid structure, measure in three orthogonal axes, allow effects on crew to be determined, measure noise levels experienced by crew. A typical example (BAe Hawk) is given. *Para 3. Flight conditions:* Advice on the selection of appropriate flight conditions. Include those manoeuvres not in original specification, are specific to the aeroplane, and produce severe vibrations. Perform same manoeuvre in each test flight to give a baseline signal. Include ground running. Record flight parameters as well.
Appendix No 1 Not used
Appendix No. 2 U.S. Military Specifications, Standards and Handbooks

Appendix B: Comparative Basis formatted in order of DEF STAN 00-970/1 (AL14) Chapter

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	17, 18	-		8.1.1
	26	-		11.1.1
	5	-		13.1.1
101	1, 2	0, 2 to 4	Operation in various climatic regions	1.1.2
	3 to 5	-		8.1.2
103	1, 6, 8	-	Operational colouring and marking	15.1.1
112	1 to 5	1	Reduction of vulnerability to battle damage	5.1.1
	2 to 4	1		6.1.2
	4, 5	1		12.1.2
114	1 to 4	1	Protection of aircrews against conventional weapons	5.1.2
PART 2 STRUCTURAL STRENGTH AND DESIGN FOR FLIGHT				
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202	1 to 5	0 to 3	Symmetric manoeuvres	2.2.1
203	1 to 10	0 to 2	Asymmetric manoeuvres	2.2.2
204	1 to 5	0 to 2	Gust loads	2.2.3
205	1 to 4	-	High lift devices and airbrakes	2.3.1
207	1, 2	-	Spinning and Spin Recovery	2.2.4
208	1, 4, 7, 8	4	Active control systems	2.3.2, 4.1.2
209	1 to 5	-	Airframe design to resist birdstrike damage	5.1.3
	2	-		12.1.3
210	1, 2	0	Radomes	2.3.3, 3.2.1, 5.2.1, 7.2.1
PART 3 STRUCTURAL STRENGTH AND DESIGN FOR OPERATION ON SPECIFIED SURFACES				
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	5	-		6.1.3
PART 4 DETAILED DESIGN AND STRENGTH OF MATERIALS				
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	4	-		3.1.2
	6			9.1.1
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409	24	-	Precautions against corrosion and deterioration	1.1.5
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00-970 (PART 13)/2	Military common fit equipment (to be published)
00-970 (PART 15)/2	Items with no military specific requirements (to be published)

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Paul J. Callus

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19. ABSTRACT

One of the impediments to the introduction of composite structure into Australian Defence Force (ADF) aircraft is the difficulty in identifying those airworthiness requirements specific to these materials. The ADF uses a comparative approach where tenderers propose their own certification basis. This is assessed against the ADF comparative certification basis to ensure that all relevant issues are covered in adequate depth. The ADF comparative certification basis is DEF STAN 00-970 [2] supplemented with AAP 7001.054 [1]. This basis was reviewed. Those requirements relevant to the airworthiness of composite structure were identified and are presented in this report. The requirements for any specific composite part will likely be a sub-set of these and must be developed on a case-by-case basis.